This is a digital copy of a book that was preserved for generations on library shelves before it was carefully scanned by Google as part of a project to make the world's books discoverable online.

It has survived long enough for the copyright to expire and the book to enter the public domain. A public domain book is one that was never subject to copyright or whose legal copyright term has expired. Whether a book is in the public domain may vary country to country. Public domain books are our gateways to the past, representing a wealth of history, culture and knowledge that's often difficult to discover.

Marks, notations and other marginalia present in the original volume will appear in this file - a reminder of this book's long journey from the publisher to a library and finally to you.

Usage guidelines

Google is proud to partner with libraries to digitize public domain materials and make them widely accessible. Public domain books belong to the public and we are merely their custodians. Nevertheless, this work is expensive, so in order to keep providing this resource, we have taken steps to prevent abuse by commercial parties, including placing technical restrictions on automated querying.

We also ask that you:

+ *Make non-commercial use of the files* We designed Google Book Search for use by individuals, and we request that you use these files for personal, non-commercial purposes.

+ *Refrain from automated querying* Do not send automated queries of any sort to Google's system: If you are conducting research on machine translation, optical character recognition or other areas where access to a large amount of text is helpful, please contact us. We encourage the use of public domain materials for these purposes and may be able to help.

+ *Maintain attribution* The Google "watermark" you see on each file is essential for informing people about this project and helping them find additional materials through Google Book Search. Please do not remove it.

+ *Keep it legal* Whatever your use, remember that you are responsible for ensuring that what you are doing is legal. Do not assume that just because we believe a book is in the public domain for users in the United States, that the work is also in the public domain for users in other countries. Whether a book is still in copyright varies from country to country, and we can't offer guidance on whether any specific use of any specific book is allowed. Please do not assume that a book's appearance in Google Book Search means it can be used in any manner anywhere in the world. Copyright infringement liability can be quite severe.

About Google Book Search

Google's mission is to organize the world's information and to make it universally accessible and useful. Google Book Search helps readers discover the world's books while helping authors and publishers reach new audiences. You can search through the full text of this book on the web at `http://books.google.com/`

SUBURBAN FARMING

SUBURBAN FARMING

A TREATISE

ON THE LAYING OUT AND CULTIVATION OF FARMS ADAPTED TO THE PRODUCE OF MILK, BUTTER AND CHEESE, EGGS, POULTRY AND PIGS

BY THE LATE

PROFESSOR JOHN DONALDSON

AUTHOR OF "A RUDIMENTARY TREATISE ON CLAY LANDS," AND NUMEROUS OTHER AGRICULTURAL WORKS AND PAPERS

WITH CONSIDERABLE ADDITIONS, ILLUSTRATING THE MORE MODERN PRACTICE

By ROBERT SCOTT BURN

AUTHOR OF "OUTLINES OF MODERN FARMING," "LANDED ESTATES MANAGEMENT," ETC., ONE OF THE AUTHORS OF "BOOK OF FARM BUILDINGS," ETC.

With numerous Illustrations

BIBLIOTHEC. APR 1878 BODLEIANA

LONDON

CROSBY LOCKWOOD & CO.

7, STATIONERS' HALL COURT, LUDGATE HILL

1877

191. i. 178.

LONDON:
PRINTED BY VIRTUE AND CO., LIMITED,
CITY ROAD.

PREFACE.

THE important position which Suburban Farming now takes amongst the other classes of farming, the causes which have led to this, and the general features of the system by which the Author has proposed to carry it out, so as to be a "paying concern," are so fully detailed in the introductory remarks, that little need here to be said by way of preface.

Suburban Farming—as indeed its name implies—claims to be ranked as a special and an important class of British farming, by reason of the demand for its special produce consequent on the expensive style of living of the ever-increasing population of our towns. The processes by which it can best be carried on vary with circumstances and opinions; these, however, differing more in points of detail than in the general principle upon which they are based. It will not, therefore, be matter of surprise, if the views held by our author as to the general system which he advocates be taken exception to by many. But, as a rule, he gives reasons for his belief in the

methods he advocates or recommends. With the general features of the system of the Author the Editor has not interfered; his chief labour in connection with the work having been here and there to alter the modes of expression used in describing certain points, and this by way of making them more easily understood by the general reader, rather than for the sake of the practical man, to whom they would have been thoroughly familiar.

The Author having apparently designed to make his work chiefly explanatory of general principles, did not conceive it necessary to enter into the description and discussion of details of practice. The Editor has deemed it desirable, therefore, to enlarge upon certain important points merely glanced at, and in some instances wholly overlooked, in the original text.

Of late very considerable improvements in practice have been introduced into several departments with marked success; and in some instances that practice has been quite revolutionised, or rather wholly superseded, by newer and more effective plans. The Editor has, therefore, to the new matter above alluded to, added other which embraces the details of this improved practice.

The various addenda of the Editor are given in type smaller than that forming the text of the work, so that the distinction between the productions of the Author and the Editor can be at once seen. These addenda, while adding to the bulk, have, it is hoped, added also to the value of the work.

As regards the illustrations, it may be stated that they have been wholly re-drawn by the Editor; this work, however, having been confined to the putting into regular form the "rough sketches" which were left by the Author, without touching upon the peculiarities of his designs. To these some new ones in the department of Cottages, &c., have been added, illustrating the more modern styles of arrangement, or of exterior design.

A novel and, the Editor trusts, a useful feature, consisting of a series of Calendars giving a concise epitome of work to be done throughout the year in connection with the management of Dairy Cows, Pigs, and Poultry, has been introduced by way of Appendix.

With these important additions it is confidently believed that the book will prove of great practical value, not only to the class for whom it is more specially designed, but also to students who are desirous to gain information regarding special points in practice which they may have only as yet considered generally.

R. S. B.

September, 1877.

CONTENTS.

PAGE

INTRODUCTORY REMARKS . . . . . 1—6

SECTION I.—MILK FARMS.

CHAP. I.—GENERAL CONSIDERATIONS CONNECTED WITH THE IMPROVEMENT OF THE FARM LANDS . . . . . 7—17

CHAP. II.—SIZE OR EXTENT, AND THE LAYING OUT AND CROPPING OF MILK FARMS . . . . . 18—29

CHAP. III.—CONJUNCTION OF MILK AND ARABLE FARMS—INCREASING THE SUPPLY OF FORAGE OR GREEN CROPS 30—47

CHAP. IV.—BUILDINGS FOR MILK FARMS . . . . . 48—59

CHAP. V.—CHOICE AND PECULIARITIES OF THE BREED OF MILCH COWS . . . . . 60—88

CHAP. VI.—GENERAL FEEDING AND PASTURAGE OF THE COWS—TRANSPORT AND TREATMENT OF THE MILK—TRANSPORTATION OF MILK—COOLING OF MILK . . . . 89—103

CHAP. VII.—CAPITAL, ETC., REQUIRED IN MILK FARMS—MANAGEMENT OF THE MILK DAIRY—IMPORTANCE OF CLEANLINESS—VESSELS EMPLOYED—GENERAL MANAGEMENT OF THE DAIRY COWS . . . . . 104—128

CHAP. VIII.—WORKING OF SUBURBAN MILK FARMS BY COMPANIES—GOVERNMENT SUPERVISION AND THE FACTORY SYSTEM OF WORKING . . . . . 129—139

SECTION II.—PIG AND POULTRY FARMS.

CHAP. I.—EXTENT AND GENERAL MANAGEMENT OF THE FARMS 140—156

CHAPTER II.—BREEDING OF PIGS, THEIR POINTS AND PECULIARITIES—PLANS OF PIGGERIES, AND METHODS OF STOCKING THEM . . . . . 157—200

CHAP. III.—POULTRY . . . . . 201—258

SECTION III.—GENERAL FARMS.

CHAP. I.—AUXILIARY FARMS—GENERAL POINTS TO BE ATTENDED TO . . . . . 259—262

CHAP. II.—ROOT CROPS—TURNIPS—POTATOES—BEETROOT—BULBS . . . . . 263—300

CHAP. III.—GRAINS—BEANS—PEASE . . . . . 301—307

CHAP. IV.—THE LIVE-STOCK OF THE FARM . . 308—313

CHAP. V.—IMPLEMENTS AND MACHINES . . . 314—316

CHAP. VI.—OUTLYING APPLIANCES OF THE FARM—ROADS—FENCES—GATES, ETC. . . . . 317—320

CHAP. VII.—THE BUILDINGS OF THE FARM . . 321—351

APPENDIX.

DAIRY COW CALENDAR . . . . . 353—358

PIG CALENDAR . . . . . 359—363

POULTRY CALENDAR . . . . . 364—368

INDEX . . . . . 369—374

A TREATISE

ON

SUBURBAN FARMING.

INTRODUCTORY REMARKS.

Of all the arts and sciences that can engage the attention and excite the industry of mankind, agriculture, or the cultivation of the earth, must be ranked among the foremost. It does not appear that any people have yet been found who were totally ignorant of this simple art, which would seem to be suggested by the very dictates of nature itself, for providing for the sustenance of man and beast. From the histories of Greece and Rome, those two great theatres of human glory, we learn that the art was practised by the rich and the great; and even after Roman grandeur had reached its zenith and was tottering to decay, agriculture still found a place in the writings of the poets and historians of both countries, some of which are yet extant. Among these the earliest allusion is to be found in a Greek poem by Hesiod in the ninth century before our era, entitled "Works and Days," and describing the labours and products of those early times, with the proper period of each performance. This record con-

tains almost all that is known of the rural economy of the Greeks.

The incidental notices found in Holy Writ to the food of the people and the cultivation of the earth do not afford any knowledge as to the means that were employed in obtaining from the soil sustentation for the very numerous population congregated on a confined and only moderately productive territory. But in the East, in which both Scripture and tradition have placed the first appearance of man, and where the arts and sciences were first brought into existence and practical use, the land was generally rich in quality, producing fruits and vegetables in abundance, and requiring little or no cultivation, as the geniality of the climate matured every article to high perfection. In most countries the species of grain were similar to those of the present day; but while the chief purposes to which they were devoted are well known, no records have yet been discovered, if indeed any were ever made, of the various processes of culture, or of the distribution of the products of the soil.

The Romans were a very acute and thoroughly practical people, and have everywhere left traces of their presence as conquerors and benefactors. Nations must be considerably advanced in civilisation before the advent of records of any kind, and still more so before agriculture finds a place among them. About the Christian era, when the Roman Empire had reached its zenith, the sphere of agriculture had become so enlarged and comprehensive as to require the most energetic application of the industrial powers of man. The records of that period are well known under the name of "Scriptores de Rei Rusticæ" in Cato, Varro, Columella, Virgil, Pliny, and Palladius. Though the

progress and practice of agriculture in any provinces of the empire cannot be traced from these writings, they furnish a valuable lesson to the present age by showing the importance of attending to minute details, which the greatest among the Romans did not consider to be beneath their notice. Their enlightened observation and experience perceived the value of suburban lands for producing in close proximity articles of constant use; and they specially recommended the cultivation of osiers or willows, which were much used for making chairs, bedsteads, and similar articles of furniture. Irrigated meadows or grass lands were also noticed, and if water were not on the spot, it was strongly advised to be taken thither for that purpose. The farm was to be maintained in the highest possible condition of fertility.

When the suns of Greece and Rome had set in the western hemisphere, the human intellect sank below zero, and became wholly obscured and inactive for a thousand years. A flood of barbarism drove every art and science for shelter into monasteries or religious houses, in which a few secluded individuals preserved the ancient learning, with the memory of civilised practices, and particularly that of cultivating the ground for sustenance, as the products of the land formed the principal source of income of these establishments. A general system of cropping the ground was the result; for necessity ever compels the practice of agriculture in some form, as no other arts can exist without it. When the inundation of barbarism had exhausted itself, the human mind became resuscitated, and, making a great movement, has spread improvement in all shapes and forms for four hundred years. During this period agriculture has enjoyed a fair share of encou-

ragement, and has attained a station of the highest rank among the mixed sciences. The notice of a suburban farm by a Roman writer sufficiently proves the value of the arrangement, and that the idea lived in the best practice of antiquity. Whatever some persons may think, agriculture is a noble art, which may be materially assisted by association with cognate sciences. No art practised by man affords a more beneficial opening for the employment of labour and capital than an agricultural undertaking, nor does any mixed science present a more varied field of exercise for the widest range of intellect. The mental and physical powers are equally brought into play—the first being engaged in the elaboration of progressive theories derived from observation and experience, aided by varied and comprehensive learning, and the latter reducing these theories into practical utility. The human mind not being fixed by entail, the dreams of one age become the science of the next.

Those who write about man in his different phases of existence, social, moral, and political, would do well to remember two things—the cultivation of the earth and the supply of the necessaries of life, for they either uphold or overturn all their ideal fabrics. No government, whatever its legislative enactments, can bestow on its subjects—no class of men have it in their power to give to another class—benefits at all comparable with the social blessings that result from sound practical undertakings. The structure of social and political theories merely displays the sandiness of the foundation and the unskilfulness of the architect; the framing of artificial codes and fiscal regulations only exhibits the erroneous conceptions and ignorance of their compilers; time and circumstances overthrow all such baseless

fabrics; but practical enterprises withstand all changes, and never fail to benefit mankind. National revolutions have been mainly caused by financial embarrassments and an inadequate supply of the comforts and necessaries of life, inducing discontent, and perilling the existence of any government neglecting a proper provision for the cravings of nature, while, curious as the expression may appear, there is great truth in the assertion that there ever exists a powerful magnetic intelligence between victuals and virtue.

Suburban farms may be very conveniently placed in three zones or distances from the nearest places of depôt, and at points within a circular continuation round the town or city. The innermost circle should contain the milk farms, producing that article and nothing else; the second circle should produce articles that are less delicate in form, and which can be used without damage from their treatment; and the third the hardiest articles of a quick consumption, but still included in the list of special productions for a fixed purpose. The whole subject may be treated in three sections as follows:—

I. Milk farms, for milk only.

II. Pig and poultry farms, consisting of pigs for roasting, small pork, and a proportion of hams and flitches; poultry, and ducks, geese, and turkeys in the different stages of growth; and eggs.

Market gardens for vegetables are placed in this section, and will form a wholly separate subject of treatment.

III. General farms, producing all the articles of general use for the accommodation of the other farms, and for supplying any deficiencies that may occur

in the various items. Wheat, barley, and oats should be grown with beans and peas for fattening animals kept in a large establishment; clovers, vetches, and hay for work-horses, cows, and store pigs; straw for litter; milch cows for suckling veal calves and for making butter and cheese; and swine for producing large hams and bacon. All these articles should be in large proportion, and the cultivation be by horse labour.

In order that these purposes may be adequately performed, the lands in the vicinity of towns and cities may be apportioned to the special purposes by a legislative authority if necessary, and improved to the required perfection by an advance of money from the national funds, and secured on the property. But capital will be found for almost any purpose on due encouragement being given in length of tenure, and in the general furniture of the land that has been conferred. Large expenditures of capital must be guaranteed by long leases and very moderate rents, and probably best on Government holdings, at a rate sufficient to pay both interest and capital within a limited period of time. In any case legislative authority should enforce the position of the farms, the improvement of the lands, and their proper devotion to the intended purposes. If the necessary funds be not directly expended by Government the money may be lent on security, or the lands may be let to capitalists on terms that will induce the expenditure. The attention of companies may be very beneficially directed to suburban farming, not only from motives of profit, but from the far preferable one of philanthropy and benevolence.

SECTION I.—MILK FARMS.

CHAPTER I.

GENERAL CONSIDERATIONS CONNECTED WITH THE IMPROVEMENT OF THE FARM LANDS.

MAN is an omnivorous animal, deriving a very promiscuous living from the produce of the ground in the ripened seeds of plants, esculent vegetables, and edible roots, and from the flesh of animals with attached products. All these articles undergo a preparation for human food, and the animal products are similarly treated. Seeds and roots are the produce of nature for the purpose of propagation; the flesh of animals sustains the body for the same purpose, secreting a fluid white and opaque that is sucked by the young of all lactiferous animals for nutriment. This fluid, under the name of milk, is used as food wherever human beings are blessed with the possession of cattle, and with various preparations beyond the natural condition. The cow is the chief animal for the purpose of yielding milk in the largest quantity and quality, the natural constitution and habits of the animal agreeing with a systematic cultivation for the special purpose. In all countries that enjoy a temperate clime,

with a moist, grassy herbage, the use of milk is most extensive, and very largely varied in fulfilling nature's offices by suckling the young, as food for children, as a mixture in the morning and evening meals of coffee and tea, as an ingredient in very many forms of sweetmeats, in the thickened form of cream, as a mixture in many artificial preparations, and in both conditions the fluid is much employed in the purposes of medicine and surgery. By agitation and coagulation milk forms the well-known articles of butter and cheese, more durable than milk and capable of a more extended utility, in a daily food and as a mixture, and as an article of convenient exportation as a national commodity. All the conditions of milk are easily enough obtained in the places of production on the lands of its growth, and in the very best condition. The supply to distant localities demands a very careful arrangement so that it be furnished in an adequate quantity fresh for daily use, and in a quality free from the mixtures and adulterations of the tricks of trade, as it forms an article almost indispensable to human existence in any civilised condition.

Like all fluids of a similar or a nearly allied production, milk is easily and quickly damaged by exposure and agitations. The particles of compositions are displaced, and do not regain the former state, and the gaseous fluids are subject to evaporation. Hence arises the value of fresh milk for daily use, and the superiority of animals that are reared by suckling over the nursing by the hand and the pail. The position must be in the nearest proximity, the carriage easy, and the agitations few, in order that the article may come into the hands of the consumer from the vessel of the cow in the shortest possible time, with the least exposure and disturbance. The distance must be the shortest that can

be obtained, leading to proper conveniences at both terminations, the travelling path smooth, beyond any jolting of the carriage and contents, with a steady motion on the best plan of railway conveyance that is known.

Milk being an article easily damaged, requires a near position to the place of consumption, and to be produced in the closest proximity to the town or city, forming the cultivation of land that is the most adjacent.*

Roman agriculture has directed that suburban farmlands be made and kept as fertile as possible, and the best modern practice understands an improved fertility to be the foundation of all successful farming in the general acceptation of the cultivation of land. The means of improving lands of any natural quality of deposit, and in any position or locality, are now well known to be by thorough draining of all wet grounds, by cleaning the soils if infested with weeds, and by manuring the lands very largely if the quality be poor. Draining must precede all other improvements, and deeply done, so that no disturbance may happen from the operations of cultivation, which may be prevented by placing at least one foot in depth of soil above the covering of the drains. Deep digging by the spade, with constant manuring with animal and vegetable matters, will produce fertility from any natural quality of original formation, as is shown by the soft thickness of chalk at the railway-stations, where gardens are formed from the rock and from the clays of the most obdurate and viscous formations of marine deposits. These processes form the primary condition of lands to be used

* [Although recent improvements in the treatment and transport of milk render this condition less stringent now than formerly, still the nearer the farm to the place of consumption for its produce the better will be the results.—Ed.]

in cultivation in an arable state or permanently in grass, and a universal improver of all lands of whatever kind consists in digging soils and placing lime shells on the breasts of the spits of land at the rate of a bushel of shells to a cubic yard of soil, and thinly in lumps, as incinerated, to be dissolved by the moisture and the permeation of air in the open position, when the caloric evolved by the shells will pervade every portion of the soil, sundering and disintegrating its particles, reducing the whole mass, warming the ground, raising the temperature, and conferring qualities not before possessed, with the sweetening effects from all carbonaceous matters; and when all the caloric has been exhausted the earthy base of the lime subsides into a mucilaginous mass, mixing with the land and adding to its fertility. By this process the most obdurate marine formations of clay, known as the Plastic, London, Gault, Lias, Clunch, Kimmeridge, and Wealden deposits, may be all changed and reduced into a loamy quality fitted to produce the most valuable plants in an ample quantity. These lands and others of a similar viscous quality, and almost all grounds, must remain two years in fallow or in fallow crops consumed on the ground, be thoroughly reduced in texture and cleared from weeds, be treated with as heavy a dose of lime and as large an allowance of farmyard dung as can be procured, and sown to form a permanent grass land without a corn crop with the following seeds in quantity on an acre of land:—

1 bushel of *Lolium perenne* (best ray or rye grass).
6 lbs. of *Trifolium pratense* (red clover).
8 lbs. of *Trifolium repens* (white clover).
6 lbs. of *Trifolium medium* (cow-grass or marsh clover).

6 lbs. of *Cynosurus cristatus* (dogstail grass).
6 lbs. of *Dactylis glomerata* (cocksfoot grass).
4 lbs. of *Festuca pratensis* (meadow fescue grass).
4 lbs. of *Poa pratensis* (smooth-stalked meadow grass).
4 lbs. of *Poa trivialis* (rough-stalked meadow grass).
4 lbs. of *Alopecurus pratensis* (foxtail grass).
4 lbs. of *Phleum pratense* (catstail grass).
4 lbs. of yellow clover-trefoil

In case of grass lands of an inferior quality being already formed, the improvements will mainly consist in deep and thorough draining, if at all requisite, with a heavy application of top-dressings of cattle-dung and well-mixed earthy materials, along with sowing of the hardy grasses, as in the list annexed. The surface of the ground, always deeply scratched and torn by harrows alternated with similar lines before and after sowing the seeds, and all covered and pressed together by a rolling weight of one ton.

On improved grass lands sow per acre—

1 bushel of *Lolium perenne* (ray grass).
8 lbs. of *Trifolium repens* (white clover).
6 lbs. of *Trifolium medium* (cow grass or marsh clover).
6 lbs. of *Cynosurus cristatus* (crested dogstail grass).
6 lbs. of *Festuca pratensis* (meadow fescue grass).
4 lbs. of *Poa pratensis* (smooth-stalked meadow grass).

Add on damp soils—

2 lbs. of *Dactylis glomerata* (cocksfoot grass).
2 lbs. of *Phleum pratense* (catstail grass).

Grass lands of the middling quality, that is superior to the average standard, may be much improved by the

constant top-dressing and sowing of seeds in near intervals after the sowing of seeds has proved successful in raising an herbage of the useful grasses, without which top-dressings are wholly misapplied, and which have a tendency to banish inferior plants and to introduce a more wiry vegetation, gramineous and leguminous. Top-dressings quick in action and short in duration are soot, pigeons' dung, guano, and bone dust, with several mineral bodies and artificial preparations of animal exuviæ and vegetable remains, which also do well on young crops of grains, legumes, and grasses. The most durable and the best suited to the purpose of permanent grass lands are from the fresh solid excreta of cattle mixed with short straws cut into lengths for litter by cutting-knives, which permits the very level and minute distribution on the grassy surface to be torn by the harrows and levelled by the roll. The dung of horses in the rough strawy condition of the stableyard is a very superior top-dressing for grass lands when spread evenly over the surface in the late autumn, and the undecayed stems raked off the ground and removed before the growth of the grasses has commenced in spring. The dung of the animals decays and sinks into the ground, forming an addition of earthy matter to the soil, while the straws cover and protect the plants from the exposure to cold and waste. The vicinity of towns affords this manure in a very advantageous manner by giving the use of the straws for the dung in return along with it. All good top-dressings act in two ways—in covering and protecting the plants and in forming an earthy addition to the staple of the soil. (For remarks on the treatment of meadow land and pastures see a succeeding chapter in this section.)

A comminuted mixture may be made of clay and any heavy earths with lime-shells in the hottest possible state of incineration which burst from moisture; and the caloric penetrates and pervades the earthy body, sunders the particles, and reduces the mass into a fine condition, which subsides at last into a quiet mucilaginous mass. The proper composition may be one bushel of lime cinders to a cubic yard of earth, carefully placed together in a longitudinal heap, with a turning over in being mixed; and again, in the period of six or nine months, when every undissolved lime-shell is carefully placed inside the heap. The contents are spread by hand over the grassy surface evenly and regularly from the laden carts in the late autumn or in the early spring, and soon after bush-harrowed and rolled with a weight of one ton. The fine earths sink minutely into the ground and add to the staple of the soil around the roots of the grasses with a consequent nourishment, while the earthy particles imbibe and have retained the caloric from the lime, imparting warmth to the plants, than which nothing is more conducive to the growth of vegetation. Being quick in action and durable in effect, this mixture forms the most valuable top-dressing for permanent grass lands, and the materials are conveniently procured in all counties where lime is moderately distant, and the earths abound everywhere. Road-scrapings, scourings of ditches, and earths of almost all kinds are thus converted into an excellent article of manure, and the lime must be largely applied. The materials are well known for supporting fertility, and the mode and cost are not beyond remuneration, which is ever most securely obtained by the constant and unsparing use of manures, which are best afforded from home production without incurring an

extraneous expense, thus making the farm to be self-supporting without much assistance, but which must be freely rendered and ungrudgingly applied.

The floating capital must be amply sufficient for the undertaking, and always exceed the demands that are required and may be expected; as of all the evils that afflict the cultivation of land and destroy the expectations of success, the want of capital is the most destructive, paralyzing energy and prohibiting advancement. A dead reserve fund is essential in order to supply defects and repair casualties that are contingent to all undertakings.

Examples of Dairy Farms,

of which milk farms, forming the subject of this section of our author's work, are but one portion or part. The department of dairy farming is one which embraces a great many details, some of these involving theoretical as well as practical considerations of great importance. To do justice to these even in the briefest of styles would occupy much more space than we have at command. Some of them have been embodied and already noticed pretty fully in the text of our author; others will be found as we proceed, in their appropriate places, in other parts of it. Meanwhile, as we find in practice that a good many useful hints are to be derived and valuable lessons learnt from a study of actual farming examples, in which the best and most advanced practice is carried out, we deem it likely to be of service to the reader to give a brief description of one or two of what may be called "example dairy farms." We use this term in preference to "model," which is apt to convey the impression that the practice is to be rigidly followed elsewhere and under all circumstances. Whereas we know that in agriculture so many varying and varied circumstances connected with soil, climate, locality, &c., come into play, tending to bring about results different in one place from those of another; thus necessitating a modification of the practice of one district to meet the requirements of another, and perhaps a totally different one. Much confusion has arisen from

the use of the word "model" as applicable to various departments of practical farming. One of the most celebrated of the dairy districts of England, celebrated no less for the richness of its pasture grasses than for that of the products which they yield, is Cheshire. From a capitally written account of the dairy farming of the county, as given in the *Journal of the Royal Agricultural Society of England* by the able editor, we prepare the following brief summary of its general principles:—

The modes of farming practised in Cheshire, according to Mr. Jenkins, are two in number. The one which is the simplest of the two is the division of the land into pasture (permanent) and arable land in varying proportions, each kept quite distinct from each other. The second, which is the most complicated of the two systems, permanent grass, forms but a small—indeed in some cases does not appear at all—portion of the land; the whole, or nearly the whole, being land down under "convertible tillage," each part being laid down for a certain term of years with seeds. The first of those two systems is that which is the most commonly practised, and scarcely requires description; the second, being less practised is less known, and it is to this description which Mr. Jenkins chiefly devotes that part of his paper. One of the farms selected is about three hundred and thirty acres in extent, and belongs to Robert Barbour, Esq., of Bolesworth Castle; it is laid out so that one-third is in permanent pasture and irrigated meadow land, one-third is cultivated on a "double four course system," followed by seeds which occupy the land eight years, while the remaining third is cultivated on a double five course system, the fifth course being occupied by seeds which remain for the next ten years. The four course 100 acres are divided into eight fields, half of which are always in seeds for pasture, the other half are laid out as follows:—(1) oats, (2) wheat, (3) beans and tares, (6) barley with clover, then the course is varied so that (3) clover is taken, then (6) wheat, (7) beans and roots, (8) then come eight years of barley with seeds, oats being left out. The five course system followed in 100 acres is also divided into ten fields, which are cropped as follows:—(1) oats, (2) wheat, (3) beans and roots, (4) barley, (5) seeds; which are repeated exactly, the seeds of the second rotation remaining another ten years in pasture.

The treatment of the cows both on the farms of Mr. Whitlow and of Mr. Jackson may be said to be very much alike. When they have nearly ceased to milk for the pasturing season, or about the beginning or middle of November, they are taken from the fields and brought into the houses or "shippons." So long as the turnip-tops last—which is up to about the middle of December generally—the cows are fed on these, and on straw chaff; when the tops fail they are replaced by sliced turnips, until just before calving-time, which is arranged generally for the end of February or the beginning of March. The food is then changed to a mixture of cut hay and straw chaff, crushed Indian corn, and oil-cake (at the rate of one to one and a half pound per day), with sometimes a little bran—the allowance of roots being diminished in proportion as that of the other food is increased. On this food the cows are kept till they calve—mangolds being sometimes substituted for turnips—when they are turned into the pasture. All the food is cut and then steamed. The cows are not, as might be supposed from the above, kept wholly "out" when turned on to the pasture, but previous to turning them out in the spring and locking them up in the autumn they are housed during the night, the hours of housing varying according to the season. The calves are allowed to suckle for the whole of the first week; for the second they are fed by hand on new milk, after which a little oatmeal gruel is given; and when about a month old or five weeks, they are fed on skim milk, linseed, and gruel. They are sold when about six weeks old, but if the best are kept they are fed and treated as above described for the older animals.

The following is the mixture of "seeds" or grasses which take their place in the general rotation in the alternate husbandry we have described, the weights named are of course per acre: 5 lbs. red clover, 2½ lbs. white Dutch do., 2½ lbs. Alsike clover, 2½ lbs. plantain, 2½ lbs. trefoil, ½ bushel Italian rye grass, and ½ bushel perennial rye grass. The "seed" crop is dressed immediately after harvest with half a cwt. to the acre of ground bones; the "seeds" being sown down with oats. The first year of cropping two cuttings of grass are obtained, the first in the month of June, the second in August; after this the crop is eat off or grazed by the dairy cows, the crop being kept thoroughly well up to

the highest point of fertility, by giving the land a dressing of ground bones—half the quantity named above—as soon as it shows any signs of going back; this liberal treatment is found to pay well. In Mr. Jackson's system of cultivation, in place of being sown down with oats the grass seeds are sown down with barley, and the mixture is as follows: 5 lbs. red clover to the acre, 2 lbs. white Dutch do., 2 lbs. of cow grass, 2 lbs. trefoil, 1 lb. Alsike, ½ bushel Italian rye grass, and 1 peck perennial do. Where the "course" requires the grasses or "seeds" to occupy the land for one year only, the mixture is the same as above, with the omission, however, of the white Dutch clover, the Alsike, and the perennial rye grass; on this, as well as on the other farm, the "seeds" are not sown till the barley has shown itself well above the ground.

The treatment of the permanent grass land is as follows on Mr. Jackson's farm. It consists of 100 acres, of which twenty are in irrigated meadows. These meadows are well drained, and are irrigated in succession from three streams, and as often as the supply of water will admit of; the grass or first crop is mown in June, but the aftermath is not made into hay, but eaten off by cows. The permanent pasture has, during the last thirty years, been manured twice with boiled bones, at the rate of half a ton per acre.

CHAPTER II.

SIZE OR EXTENT, AND THE LAYING OUT AND CROPPING OF MILK FARMS.

THE average size of milk farms may be stated at about 200 acres, of which the description and use may serve for the different modifications of extent that may arise from inclination and convenience, and two-thirds of the quantity of acres being kept in a state of permanent grass of a richness to produce a full crop of hay in the best perennial grass plants for winter provender, with a crop of lattermath herbage nearly or fully as large as the first crop, to be consumed as green food by the cows in the sheds and yards of the homestead. This second crop of grasses may be made into hay, in cases of the green food being abundant from other sources, and the supply of dry provender being less in the amount. This condition of the grounds must be produced and upheld by the highest treatment of manuring, and by the sowing of seeds, if necessary; the primary improvement of grass lands has been already detailed. The grounds must be divided by means of fences in posts and rails into fields of about twenty acres in order to allow the grazing of the lands in alternation with the hay-cutting in perpetuity, which is a heavy charge on the capabilities of the soil.* The

* [Repeated change of pasture, so as to afford the animals what is termed a fresh "bite," is found in the practice of grazing to be so beneficial, that it is desirable to have a greater number of small fields —even of less extent than that named in the text—than a less number of greater acreage.—ED.]

grazing of the grass lands one year in four or six years of mowing will tend to improve the herbage of wiry grasses and also of the clover plants. This result comes from every top-dressing of grass lands, especially from a manure of the carbonaceous nature, as the earthy mass of soil and lime that has been recommended. Clovers seem to be specially attracted by that mixture. The third part of the land in cultivation will be divided into four or five portions, with the one-half growing root crops: Swedish turnips on the best favoured soils, beet-root on the stiffer varieties of land for turnips, potatoes in a fair amount of acreage, with cabbages on all lands of a clayey texture, known as the best loamy clays or clayey loams, deep in the deposit and damp in the composition. The grain crops in wheat, barley, and oats are sown on fallowed lands for domestic purposes and for litter in the yards and sheds, and the intervening crops of winter tares and of spring vetches are raised for green food early in and through the summer, and constitute a most valuable part of sustenance for animal life, and very especially for such a purpose as the production of milk, which requires the essential provision of moisture provided in a succulent food. For this purpose the vetch plants are most peculiarly favourable, being juicy and otherwise of an easy digestible composition, and much urine is voided for the purpose of manure with fæces and straws in mixture that are of drier composition. The plants form a very valuable and a most essential consideration in every arrangement for the support of animal life. Red clover is grown on the barley tilth as a green food of the very first quality, and along with ray grass and fescue forms in hay a dry food of the highest value, and scarcely equalled by any vegetable yet known.

The wiry plants of ray grass and fescue correct the succulency of the juicy clover, forming a nutriment to animals of an almost equal value for stall feeding; but its greatest value is for green food in the sheds and yards, and in that position the plant is all but invaluable. In favourable situations of deep, rich, and moderately moist loamy lands in sheltered exposures, a crop of lucerne will answer a good purpose, as the produce is abundant, juicy, and succulent when used in the tender state and not allowed to rise into the age of decaying leaves and of ligneous stems, which soon follow in a speedy succession from a healthy condition of the plant. From these considerations lucerne is ineligible for hay, and very inferior to red clover and vetches as an article of greenmeat. The plant requires the very best encouragement, and to be treated with frequent top-dressings with rich and finely comminuted composts, with lime as a chief ingredient. The spring growth is early and comes into use in the most critical period, before the summer growths have arrived. The plant fails in comparison with red clover for the purpose of hay and for green food, but may be useful as an auxiliary in a secondary estimate of utility.

Swedish turnips are a primary consideration as winter food, in the raw condition or steamed along with chaff of hays and straws, where the liquid part of the preparation with the bulbs forms a juicy nutriment for the secretion of milk and more solid elements to produce the flesh and bones of the animal frame. The turnip in a raw state is highly estimated, as the bulb possesses the peculiar quality of encouraging milk and of forming solids, and hence the larger value of the root in all the cultivation of land for the support of organic life.

Field beetroot or mangel-wurzel is more milky than fleshy in the tendency as food for animals, and the milk may be something thinner in the quality than from turnips; but when steamed in a mixture with chaffs the difference may be trivial and scarcely perceptible. The growth of the plant is easier than of the turnip, the seed is strong and larger, and indulges in a stiffer loam, of soil of a deeper body, that is damp and moist. The allowance must be large of manure from the fæcal dung of the yards with the litter of straws cut into short lengths by the chaff-cutting machines, in which condition the mixture will be much facilitated in the handling and in the covering in the land and drills, and in the mixing of the dung and urine of the animals with an easier decomposition of the straws in the ground. The plants are thinned into a single standard at the same distance as of turnips, and the growth has been much assisted by the application of superphosphate of lime. But these substances are costly and not lasting in effect, though exertion must be made to procure such invaluable an article as mangel-wurzel, even at the cost of raising the plant only. The produce is heavy beyond most root crops, and the quality is very agreeable to the taste of cattle, either in a raw or steamed condition; but on shallow lands of inferior quality the turnip is far more generally useful than the field beet, of which the taproot requires a depth of soil in which to thrive, with an abundance of dung. The depth of any natural formation can be made by digging deeply and mixing with lime, as has been already detailed, and must be done as the primary preparation of lands for the present purposes. A foundation must be made before any superstructure is raised.

Cabbages yield a large produce of leaves, which

are much relished as food by all ruminant animals. The large bulbous heads of leaves requires an ample sustenance from the roots, and much from the atmosphere; the strong stems and the widely spreading fibrous roots show a coarse organization that demands a rank supply of food from the strength of the land, in deep clayey loams that are damp and clammy, and treated with a large allowance of cattle-dung in a fresh condition. The bulbs or heads are stored for winter use after being denuded of the outer loose leaves in partial decay, which impart the nauseous taste to the milk from the use of cabbages. The careful removal of incipient decay in the outer leaves prevents the taste, and also the infection of the inner leaves from the outer contact. The bulbs are consumed in the raw condition or are steamed along with chaffs.

Potatoes are grown in a necessary extent for domestic use, and for feeding the poultry and the few pigs that are kept in all the arable applications of land.

The provision of green food for the use of store and fattening animals on farms of any kind in the British Isles, in which animal life forms the primary department, is ever the chief consideration, and the neglect of which shows a complete ignorance of the business. The attention is very largely increased on farms of which the animal production constitutes the chief dependence, and supports the whole weight of the undertaking. Winter vetches occupy the first position, clovers are the second in use, spring vetches occupy the third position, and being sown in three divisions of time—in the end of March, in the middle of May, and in the end of June—the supply of herbage will continue over September. Lucerne will assist the use of greenmeat in the early cuttings of the plant. A part of the per-

manent grass lands may be cut for green food in the first and second crops, and a field may be pastured which will much assist and relieve the heavy demand for green food. (See remarks on the subject of extending the supply of forage and green food in a succeeding note.)

The winter provision, in meadow hay, turnips, cabbages, and mangel-wurzel continues into May, and longer, according to circumstances—all the articles being made as juicy as possible by steaming into a liquid consistence. The regular supply of green food is too much neglected in the general farming of Britain. In the case of milk farms, the provision of roots and legumes forms the primary consideration in the arrangement and management of the lands devoted to this special purpose.

The grains of wheat, barley, and oats are used in domestic consumption, and beans and peas may be added in a small ratio for the pigs and poultry required for domestic use in connection with an arable farm. Oats are required for the horses that cultivate the arable lands in rotation; barley is necessary for the pigs and poultry, and for any special use by the cows; and wheat produces the flour for domestic purposes. The straws of these grains are most essentially required for litter in the sheds and yards of the cows, to be converted into a manure of *the first* quality, and in quantity to support *the fertility* of the lands without any extraneous purchases, except in a small quantity of best auxiliaries, as bones and guano, to raise by top-dressings the tender young crops of the spring. Such establishments for certain purposes must be made to be self-supporting, selling largely and purchasing little. The straws are cut into short lengths

by knives impelled by the threshing machinery, which renders the handling of the dung more convenient, and the mixing and impregnation more easily effected with the fæces and urine of the animals. The application to the land is done in a fresh condition, for after all that has been written and spoken on the subject of fermentation and evaporation, the supposed advantages have been very sufficiently contradicted by an attentive experience. Manures in a fresh condition possess and exert the animal heat very beneficially for the growth of plants, and fermentation loses much in quantity, and exposure only dissipates certain qualities and imbibes others. For top-dressings the fresh condition yields the largest bulk to cover the surface of the ground, and we maintain a most decided preference for the system of spreading them over the land in the late autumn of the year. In the dry weather of March or April the bush-harrow tears and scatters the dung, and a heavy rolling will press together the soil and particles of dung, and prepare the surface for the level work of the scythes, and leave no obstructions from stones or knolls. These operations being properly done, considerable saving will be effected in the work throughout.

Points to be attended to in the Converting of Arable into Meadow Land; and in the General Management of Meadows.

In the *meadow* department of the dairy farm much loss arises from the neglect of the proper rules which regulate their laying down, sowing, cutting—in short, their general management; the result being that the grass which they produce and the consequent or following crop of hay is poor and innutritious, but not only so, it is often, much of it, absolutely bad in its influence upon the stock fed upon it. This arises from the fact that many noxious weeds and rank unwholesome grasses are so mixed with those grasses, which are good or moderately so, that not being able to be separated—

if, indeed, some farmers knew when the produce was bad—they are partaken of equally with these. The origin of bad meadows may be said to date from the very beginning of their laying down, that is in the case of meadows which have been made out of or been preceded by crops of land under arable culture. When, from some predisposing cause, it is determined to lay down lands of this kind into grass land, meadow, or pasture—and, as our readers are aware, there has been much agitation on this point, many advocating the system as paying better than arable cropping—there is too often an almost thorough neglect of the only methods by which the meadows can pay. The chief of these is the supplying to the soil the constituents of which a long succession of arable crops has robbed it—a succession or style of cropping all the more exhausting in many cases from the low manuring which the crops have at the same time received. The result of this is that the soil, being fairly deprived or exhausted of its fertilising constituents, is in a condition wholly unfitted to bear crops of grass. Again—and this will likely have been the case in heavy lands—the cropping may have been carried on with very little attention having been paid to weeding and cleaning the land and deeply stirring it, to which may be added the probability in other cases that drainage has been neglected, and, if carried out, shallow in place of deep drains have likely been laid, or drains otherwise defective as regards either distance apart and mode of construction and laying down.

Land thus deprived of the fertilising constituents necessary to maintain vegetable growth in proper vigorous condition, and infested, moreover, with weeds—which seem to thrive where useful plants die or languish for lack of sustenance—must be put under a proper course of preparatory culture before the grass seeds are sown down. It does not come within the scope of these remarks to enter into details as to what this cultivation should be; suffice it to say, that if the land be very foul, that is much infested with weeds, and if on heavy land, which under arable culture would be fallowed during part of the rotation, the first thing to do on breaking up the land would be to place it, if not under a bare or summer fallow, to have it under fallow crops the first season, these being subjected to a vigorous course of stirring the soil between the drills, weeding, and cleaning. An essential

part of the operation would be breaking up the land in the autumn, this being done as early as possible, using by preference the grubber, so as to leave the surface rough and broken to be under the atmospheric influences of winter and early spring as long as possible. If the land can be worked with the steam grubber the results will be all the more satisfactory. It is needless to say that the crops preceding the laying down of the land to grass should be judiciously manured, and if the soil be light and poor it would not be a bad plan to grow some forage crop and plough it in as manure, or to take a root crop and eat it off by sheep, which would at once manure and consolidate the soil.

Seeding down of Grasses.

The land being thus properly cleaned, deeply stirred, and well manured, the next thing to be done is laying it down with grasses. And here it is impossible to refrain from severely criticising the course at this stage taken by some who, either through indifference and carelessness as to ultimate results, ignorance of the kinds and qualities suitable to the soil, or, what we deem worst of all, a desire to save a few shillings in the cost of the operation, lay down grass seeds of the cheapest kind and most inferior quality, and largely mixed, as seeds of such kinds are, with the seeds of weeds, the plants of which, growing with the usual vigour of plants not wanted, are difficult to eradicate, greatly exhaust the soil, and by consequence reduce the value of the grass crop proper. The dearest is the cheapest in such a case as this, as there is no economy, but the very reverse, in buying poor seed, for although other things are necessary to be attended to, it is nevertheless true that as the seed so the produce. The best and wisest course to pursue after the land has been got into thoroughly good heart will be to take the advice of a first-rate seedsman, who, upon examining or being made acquainted with the nature of the soil and its previous preparation, will be able to supply the seeds suitable, and these of the best quality. What little extra expenditure this may involve will in every way be well repaid.

The grass being laid down, it may be advisable to give the early growth a top-dressing of some good and appropriate manure; chalk, marl, clay, and soot, if cheaply got, and

nitrate of soda, of the dearer kinds, may be used, according to circumstances of soil, &c., &c., and the practice should be avoided of putting on cattle or stock to pasture, with the idea that some food will thus be obtained without injuring the main crop for cutting for hay. There can be no greater mistake made than arresting the growth of the young grasses, either by this plan or by too early cutting. A good bottom of grass ought to be secured first, this will be a sound basis upon which to found often and successful working.

Cautions to be observed in regard to Second Crops, and of pasturing Stock upon Meadow Land in Autumn and Spring.

After the first crop has been taken from the land—and this applies to old meadow as well as new meadow land—it is another great mistake to send in stock to feed after the "aftermath," "eddich," or second crop of hay has been taken off. Indeed, unless the season be early, and in other respects a favourable one for haymaking, and the second crop specially good, it is very doubtful whether anything is to be gained by taking the "aftermath," or second crop, off the land. If the second crop be a moderately good one, yet not likely to pay for the cost of making it into hay, and if the weather be "catching" or treacherous, it may be the better plan not to cut it for hay, but to have light cuttings taken off for soiling cattle in the house. It is only in specially good seasons and with specially good land that aftermath hay crops pay; as a rule in many northern districts they are not worth the trouble and cost they involve, to say nothing as to the injury done to the crop. But even in cases where, with very favourable locality as regards climate, weather, and soil, a really good second crop of hay can be secured, and however good and rapid may be the growth of the grass succeeding the second crop, we should assuredly deprecate the system of sending in stock to feed it off. Infinitely better results will follow if the grass is allowed to remain on the land; it will afford a fine shelter for the young grasses in the ensuing winter and the succeeding early spring months against the severe frosts and bitter winds, which do so much damage by nipping and retarding their growth. The beneficial effects on herbage, and upon grow-

ing crops of all kinds, even when that shelter is so slight as to be scarcely observable, and certainly beneath the notice of the great majority of ordinary observers, is well known, and was first in a spécial manner experimented and dwelt upon by the late Mr. G. Gurney. But while deprecating the habit or custom of allowing live stock to pasture on and feed off meadow land in the autumn, we not the less do so in regard to that system when followed in spring. Spring pasturing acts very much in the same way as autumn pasturing; both expose the roots and prevent them from being sheltered, autumn pasturing against the frosts, spring against these and also the sun. And as eating down in both cases tends greatly to retard the growth and weaken the plants, as they are not able to gain that recuperative force necessary to enable them to push on and make a vigorous growth before the cold of one season and the heat of another sets in, the plants being in both cases exposed and in a weakly condition, and less able to stand the exposure, greater loss is thus sustained than is generally thought of. The truth is that both of these practices or systems originate in a mistaken notion of the real part meadow land plays in farm economy. A meadow is for the purpose of raising grass to be cut and made into hay; it is not designed to serve as pasture land, and it is only in exceptional cases that it ought to be used as such. The two processes, haymaking and pasturing off the same land, are not compatible, that is when the true objects of each are considered.

Loss sustained by allowing Meadow Grasses to be over-ripe.

The last point we would draw attention to as regards the mismanagement of meadow land, is the practice of allowing the grass to remain too long upon the land before being cut for haymaking; the grass in this case being over-ripe, of necessity has withdrawn from the soil more of its fertilising constituents, and has thus weakened the soil; and the supposed gain is in fact a double loss, for it not only weakens the soil, but it adds to the woody portion of the grasses, and in proportion lessens the nutritious portions of them. In truth it may in some instances be said that the practice involves a threefold or treble loss, inasmuch as, by following it, many "a good spell of weather" is lost every season, and will, doubt-

less, be lost in seasons yet to come, in too many districts, through the farmers all waiting to give, as they say, "the chance of their getting a heavier crop by allowing it to grow in this fine weather." Now let it be understood and believed in, as a fact of which there is not the "slightest shadow of a shade" of doubt, that after a certain period in the growth of meadow grasses and artificial grasses, such as Italian rye-grass, there is not only no increase in the weight or quantity—if this latter incorrect word can or should be used—but positively, so far from being any improvement, there is a positive decrease in the quality (the feeding quality) of the grasses. When, in the case of general or mixed meadow grasses, they *begin* to burst into or form the flower, then is the time to cut them; in the case of Italian rye-grass, the flowers may be allowed to come out slightly, in clover into full blossom. But it is the greatest folly to throw away good weather in the hope that the grasses will be the better by standing longer in the ground, often till the seeds are dead ripe and shake out on every movement; and this apart from the fact that the goodness of the grass is wasted by the soil constituents being given to the seed, which is not wanted, grass, not seed, being required. Where grass is grown for seed, the process of haymaking or saving the grass is different from the ordinary one. In most works on farming there are tables showing the periods at which the different grasses flower.

CHAPTER III.

CONJUNCTION OF MILK AND ARABLE FARMS—INCREASING THE SUPPLY OF FORAGE OR GREEN CROPS.

It may be doubted with propriety, and even questioned by expediency, if milk-farming and arable cultivation should be joined, as the one sole article of milk may be produced without any subsidiary aid. But in most cases it is required to employ some variety of means in order to reach a point of practical economy, and to produce a result that secures the desired object. The kind and the number of the agents that are to be employed will be regulated by the business which is the object of the ultimate attainment. Milk is a complex substance depending both in quantity and quality upon the constitutional organism of the animal from which it is extracted, and in the same ratio of the articles that are supplied for nutriment to the assimilating functions of organic life. Animals have fortunately at command a large variety of articles of food from the spontaneous vegetation of nature, which have been selected by observation and experience as yielding the best qualities for the purpose of secretion and for the general support of the animal in a healthy condition. Grasses and roots have been found the chief articles of domesticated food in a green or dried condition, and the latter prepared by steaming or boiling. Grasses are a drier article than juicy roots, and the

different qualities are found to be very beneficially mixed for the purpose of nutriment both in the process of milking and of fattening. Farms composed wholly of grass lands produce only green food and a dried provender of the same materials of a standing quality, and recourse is had to the purchase of roots and liquid refuse from brewing and distillation to relieve in some degree the sameness of the food. This expenditure may be saved by a more beneficial outlay in raising the succulent root and other food on the farm, which employs labour and improves the land, besides affording a nutriment of the quality that is most favourable to more than a single purpose. Milch cows require a juicy food of good quality and also a considerable quantity, as the maw is voracious and large for devouring; and if it be objected that roots impart a taste to the milk, as in the case of cabbages, the fault is wholly removed by the process of steaming, which is the most approved method of using the roots and chaffs in conjunction for the secretion of milk. Barren cows may be fed with raw roots and straw chaff. The cost of purchasing these foods is better employed by raising them as home growths in all cases of possible application.

The same necessity exists of procuring green food in summer as in winter, which is enlarged by the effects of dry and warm seasons on all organic life. Juicy food must counteract the effects of climate to promote the secretion of milk, and also to afford the flesh and muscle that is necessary to the healthy condition of the animal. For these purposes a mixture must be made of the early crops of permanent grass with the foremost vetches and clovers, the wiry grasses most beneficially correcting the juicy plants of clover and the vetch, which afford the fluids of the body, and the grasses

yield the fleshy portion of the structure. The foremost crop of permanent grasses will be extended almost to meet the lattermath in supplying the mixture, while the clovers with a portion of grasses as for hay will afford the special food without any way mixing with other plants. The vetches in sowings of two and three weeks' interval will be found a most useful provision, being very grateful to the taste of the animals as a very agreeable juicy food. It produces a large fæcal excrement with much urine, creating a valuable manure, an acquisition almost invaluable in all kinds of farming, for no person will ever succeed in any branch of the cultivation of land who does not apply manures with a constant, a lavish, and an unsparing hand.

Increasing the Supply of Forage Crops for feeding on Dairy Farms.

In the carrying on of dairy farming there is nothing, perhaps, which tries the patience and tests the temper so much as running short of the supply of home-grown produce required to feed the dairy cows. Nor does the trying circumstance affect the farmers, which is bad enough, but it is obvious that it must exercise a bad influence upon the productive powers as well as upon the health of the stock. Few farmers like to purchase extraneous supplies of food, there being in the enforced practice something derogatory to their status as successful farmers; and the food, moreover, so bought, especially if it be artificial or foreign-grown produce, does not always meet the necessities of the case, being often unsuitable for the animals, in addition to its being, as a rule, high-priced. At the best it is but a costly way of getting out of a difficulty, which one is inclined to think would not so often arise if another system of farming was adopted—one which gave a wider variety of crops grown for feeding purposes. A full and unprejudiced view of the whole circumstances will, we think, tend to show that a much wider variety of green or forage crops useful for the feeding of dairy cows could be grown than is usually, we

may say universally, met with, or rather not met with, in the farms of this country, is well known to those who are acquainted with the peculiarities of continental farming. And that a variety of green feeding substances would play an important part in dairy farming there can be no doubt. There are few seasons pass over the heads of dairy farmers without their feeling in greater or less degree the difficulties which they meet with arising from the lack of supplies of home-grown food. These come up, moreover, precisely at the worst time, namely, spring and autumn—at the one period when the pasture grasses are behind and poor, in consequence of a severe and protracted winter or an ungenial spring; and at the other when the pastures are bare either from having been thoroughly—and, for the matter of that, unwisely—eaten off, or through a dry or otherwise untoward middle period. Nor sometimes is the lack of food the less severely felt at the period of summer, when the pastures should be at their very best, but when, through severe droughts or other causes, they are far from this, but withered and dried, poor or parched. The difficulties are all the more keenly felt, and perhaps the more impracticable to be dealt with, if stall feeding or "summer soiling" has been arranged to be carried out, and is the principle adopted on the farm.

Now, it may be said that when such difficulties occur they may be got over by the purchasing of food from sources external to the farm, from neighbours, or from those who deal in artificial and foreign foods, &c. But while this, no doubt, is an easy way of getting rid of the difficulties of short supplies of home produce, it should be recollected, as already hinted at both in the author's text and in this note, that while easy it is very expensive. Moreover, it is in one sense worse than this, inasmuch as the foods, however good they may be, are not so good in the sense of promoting to the best advantage either the milking capabilites or the health of the cows. For such foods as are bought from food-sellers are not the natural foods which the animals require, and, as may be said, their constitutions and habits lead them to expect; for at the seasons we have named, especially the spring and summer, succulent foods—not dry ones, as artificial or bought foods are—are what may be called, and indeed are, the natural ones. True, if bought from neighbours

they may be of this class, but the probability is that the causes which have brought about a deficiency on the dairyman's farm have in a similar way brought them about on the farms of his neighbours. And although the bought foods, by grinding, &c., and by being prepared as mashes, may be more palatable to, and will better act upon, the milking powers of the cows than if given dry, still at the best they do not come up to the natural foods of the seasons.

But it may be said that even although a greater variety of green or forage foods for cutting, &c., may be grown, the same causes which brought about a deficiency in the pastures—or say such forage crops few in number as may have been grown—will also have effected these extra ones. But this by no means follows, as each plant has its own habit of growth, and some are better adapted to flourish in certain states of the weather or conditions of the soil; the great probability, indeed the almost certainty, is that all will not fail —that, if some do, some also will be left and found to yield largely. It is, in short, an exemplification of the same principle which regulates the system of mixed husbandry farming, and which constitutes it the safest for the farmer; as all crops will not be lost in such untoward seasons, as would destroy the hopes of the husbandman if he relied upon one or two only. It is not necessary, and indeed it is not easy, in the necessarily limited space at command, to give here a statement of the details of the system to be adopted so as to secure a much wider variety of foods for the cows than is met with, as a rule, in dairy farms in this country, or even upon those farms which professedly cultivate crops to meet the requirements of dairy farmers. These details will be regulated by the peculiar conditions of the farm; but by a careful study of the whole subject of farm cropping the farmer ought to be able to devise a system suitable for his circumstances. Thus we might note the quick successive crops he can obtain from *Italian rye-grass*, especially if liquid manure is obtainable to force them on; by the use of this, enormous crops have been and are obtained from this source alone. Then there are the *summer rapes* and the *mustards*, which grow with great rapidity in a wide variety of soils, and under comparatively—in some remarkably—easy systems of culture; and of which the cows are especially fond, and which at the same time increase the flow and often the rich-

ness of the milk. Another forage crop, which is well adapted for the feeding of dairy cows, as increasing the yield and quality of their milk, is *chicory*. This is grown to but a limited extent, and chiefly in one county in this country, and that for the roots sold for the making of chicory to be mixed when roasted and ground with coffee. On the Continent, however, the leaves are used extensively as forage for cattle and cows, successive cuttings being obtained before the roots are taken up for the above-named purpose. The crops of forage thus obtained are, as a rule, large, and the stems and leaves afford a succulent and nutritious food. The seed is sown in drills at intervals of from ten to fifteen inches, and the plants are singled out in spaces of from nine to ten inches. The crop suits best a light soil; it should follow a grain crop, and the land ought to be well manured with farmyard dung. The quantity of seed is 4 lbs. to the acre for drill for a succession of cuttings. The crop is sometimes grown as a purely grazing one, in which case the seed is sown broadcast, 12 lbs. to the acre. Another crop, not much grown with us, but extensively abroad, and one of which sheep are particularly fond, although cattle and cows also like it, is the *lupine*. If grown in drills that are twelve to eighteen inches apart, a fifth of a bushel of seed to the acre is used. Another forage specially adapted for dairy cows is the *lucerne*, for which crop, a deep and dry soil is best suited. It grows best in drills eighteen inches apart, and affords a succession of cuttings. If got in early in the season a cutting may be obtained in August or September; the second year it should yield three cuttings, but the third and the following years, in which it may be kept on the land, by careful weeding and top-dressing with manures, as many as five or six cuttings may be had; and as the plant grows to a height of eighteen to thirty-six inches, and gives good leafage and stems, a large amount of feeding will thus be at the service of the dairyman or stock-keeper. In cutting, some two or three inches of the stem must be left above the drill tops. Another crop which, like the lucerne is perennial, and requires a deep soil and dry, to admit of the roots going deep down, is the *sainfoin*. The soil must not only be deep, as just stated, but well drained, and must possess lime as one of its constituents; dry calcareous (chalky) soils therefore suit it best. Both *sainfoin* and lucerne must be kept very clean and free from weeds if full crops are obtained.

Sainfoin is cultivated very much like the lucerne; the seed per acre is from 10 to 20 lbs; it is usual to sow it down with the barley crop, like the ordinary seeds or grasses (artificial).

There are on many farms pieces of waste land, the sloping sides of banks of rising ground, or on the margin of rivers, on which *gorse*, furze, or whin grow, for by those names the same plant or shrub is known in England, Ireland, and Scotland respectively. Now as a rule this plant, shrub, or bush is allowed simply to grow unheeded, or, if noticed at all, it is to be looked upon as a nuisance to be cut down, burned, or otherwise got rid of. To many, therefore, it will be somewhat a novelty to be informed that as a forage plant it possesses many valuable properties, and is not only much liked by dairy cows, but its use promotes the flow and increases the richness of the milk. Horses are also fond of and thrive well upon it. Those who know its value go the length of specially cultivating it; it may be grown upon any soil—at least, a very wide range of soils will suit it—and after the plants have arrived at a certain stage of maturity they afford a succession of cuttings. These cuttings, must, however, be passed through a gorse-bruising machine, or be well broken or crushed by hand mallet, in the case of small farms, in order to get rid of the sharp spikelets before they are given to the stock. The cuttings from the plants should be arranged in succession; those plants which have been cut last being those which are to be allowed to grow for the longest period before cuttings are taken from them again. A little consideration will enable the farmer to decide on the arrangement to secure this succession of cuttings in the most economical way. One great advantage possessed by the gorse is that it gives a good supply of green forage food during the winter months, being almost the only source from which such can be obtained during this period of the year—an advantage this which will or ought to be fully appreciated by the dairyman. We should by no means counsel the ruthless cutting down and getting rid of such gorse trees or plants which may already occupy such plots of land as we have named above, but rather the careful going over of the whole to see which of the plants being so old or otherwise have got so worthless may be got rid of, the soil occupied by them being grubbed up or dug, and well cleaned

from weeds, and fresh plants transplanted, or seed sown for a new crop. It would also repay the labour if the whole plot of the trees or shrubs which are left in were gone over, moving the soil around and between the trees or shrubs, and, perhaps, if it can be spared, adding a little manure. But in any case the weeds, grass, and undergrowth, of whatever kind, should be carefully removed, the gorse, like all other valuable crops, not doing well with weeds. Where the gorse is specially cultivated the land should be well prepared; the seed is best sown in drills from tweny-three to twenty-four inches wide, the most favourable period being the end of March—the quantity of seed 8 to 10 lbs. the acre. The first regular cutting will be ready by the autumn of the year succeeding that of sowing. Sown in drills the seedlings will come up thick and close; a good many plants will, if removed, give free space for those remaining to grow in, and many of the plants taken out will be useful in filling up the spaces of the waste land plots, where old gorse-bushes have been taken out as named above.

There are plants other than those now named which might, with economical advantage, be grown for forage purposes. The most recently introduced, or rather that to which the attention of farmers has been most recently called —for it is by no means a plant new to the agricultural world—is the "Caucasian prickly comfrey." It resembles the Jerusalem artichoke in one respect, that the first cropping of the soil is the only one needed, as when once the plants are fairly established no extra labour is required, save in the weeding and occasional stirring of the soil between the drills or stools, these being placed at intervals say three feet apart, or about 4,800 to the acre. The general culture resembles that required for the potato. The comfrey does with a wide variety of soils, being specially and fortunately adapted for those which are apt to be dried up, for the plant is such a deep-roooted one, and will send the rootlets so far down in search of moisture, that it will flourish in soils and in seasons so dry, when other crops will be fairly scorched or greatly hindered in their growth. The prickly comfrey possesses also this advantage in common with other of our most valuable forage crops, that it is equally good when used in its green state as when dried for hay; and, further, no part of it is lost, as the branches and leaves, if also

dried and tied up into bundles, will afford a good food for winter when other food is scarce or dear. But the most striking point connected with the comfrey here noticed is the extraordinary amount of produce which it yields; thus, while the most prolific of the artificial grasses, Italian rye-grass, will yield on an average fifty to sixty tons per acre, lucerne forty, green cut vetches twenty, and good grass from meadow or pasture land cut green only eight tons to the acre, the Caucasian prickly comfrey will yield as much as from eighty up even to 120 tons per acre. The plant grows rapidly, and has a rich luxurious development of leaves and branches, and, as regards its feeding properties, it is liked by all varieties of stock, especially cattle; and for dairy cows it is peculiarly valuable, as it not only is greatly liked by them, but it is well calculated to increase the yield of milk. Altogether, the plant is worthy of having the attention of the dairy farmer paid to it, who is often greatly hindered in his work from lack of food for his cows. Further information, as well as the "sets" or cuttings, can be obtained from Messrs. James Dickson and Sons, of Chester, the well-known seedsmen. We do not know whether this plant, valuable as it is, will add another to the somewhat long list of plants for forage purposes which have, from time to time, been introduced to the notice of the farmer, have attracted a great deal of attention, been much written and talked about, and then, after a season, have been quickly relegated to what figuratively is called the "tomb of all the Capulets," to forgetfulness and neglect. Of these, perhaps, none during more recent times attracted greater notice than the Sorghum saccharatus, or North American sugar-cane. This was highly spoken of as a forage plant adapted for a wide variety of soils, such as could be worked to a deep tilth, and producing a large amount of food from a succession of cuttings. It may be cultivated either drill fashion from seed or from transplanted plants from a seed-bed; if raised from seed the period of sowing is May, if from plants the transplanting may be done as late as July, June, however, being the best month. It does best in a warm climate, and is not suited therefore for northern districts. As regards the fact above noticed, that its reputation has dwindled gradually away till it is rarely or ever spoken about now, it may be here remarked, what, however, seems to be too readily

forgotten, that if a plant is, or has been, proved at any time to be really good, no amount of neglect which it may subsequently receive can alter this fact; it will be as good as ever, although less esteemed and less used. The neglect with which so many things are visited is easily enough accounted for, but the above should not be forgot; and that therefore one need not be deterred from trying a plant for example which has fallen into this category of forgotten things. By adopting in conjunction with this varied system of plant or forage-culture that of the "stolen crop," the farmer will often be delighted to find that, whereas when otherwise under the old system, which in many districts has but one crop to depend upon, namely, the grass, he would have been short of the food best adapted for his cows, and in every sense best liked by them, he will have ample supplies of some to make up the deficiencies of others. Another plant which may be grown with great advantage on farms where poultry are kept is the sunflower. This crop is to poultry what the buckwheat flower is to bees, of which, by the way, a patch should be sown for the special use of those insects where they are kept for honey-making purposes. The sunflower is a special favourite with poultry, and adds, when given to them judiciously, to their weight and the richness of their flesh, and to that of their eggs. The plant is easily grown; like the artichoke, it will flourish in almost any kind of soil, however poor; and it is admirably adapted for filling up waste corners, strips, and odd bits of land on which nothing else will grow, or is supposed to be able to grow, since they are universally allowed to lie idle, yielding nothing. We are wrong in this; they yield an abundant crop of weeds, the seeds of which spread and are carried by winds, birds, &c., to places where they are a nuisance and a loss; so that by utilising these waste bits of land—for which, be it remembered, and the fact is generally quite overlooked, rent must be paid, as they are all "measured in" as forming part of the acreage of the farm—in one or other of the ways we have pointed out, a double benefit is secured—we get a crop and save a waste of weeds. But we do not exhaust the value of the plant when we allude to it as useful for poultry. The leaves are greatly liked by pigs, and they may thus come in usefully at a time when green food of other kinds is too scarce, or, perhaps, scarcely to be had at all, to

be given to these useful but too often neglected "Ishmaelites of the farm." Indeed, for the matter of that, a good kitchen vegetable may be obtained by taking the seed receptacles, in the early stages of their growth, and cooking them after the fashion of the artichoke (not the Jerusalem). Further, the dried stems will be found most useful in the kitchen as a fuel or a kindling material for fires, for which purpose they are so valuable that, in some countries, as America, the plants are cultivated for this alone; and to show the varied value of this despised, neglected plant, the seeds which may not be used for poultry will yield on pressure a remarkably pure oil for the lamps of the farmhouse or cottage, while the refuse of the crushing process is highly valuable as a feeding oil-cake for cattle. So much for a plant which will grow almost anywhere, and grows luxuriantly even in this weeping climate of ours, is easily cultivated, and of which the seed costs but a trifle. It is best dibbled in early in spring, and with a fair amount of space between the dibble holes—say nine to ten inches, or a foot—for we have grown the seed-pods to a diameter much exceeding this latter width.

An arable portion of a grass farm is also required to produce the necessary articles of domestic use, of which the constant purchase will be troublesome and very inconvenient. The domestic purposes of the family of the farmer demand a constant and regular supply of necessaries that are only to be got as the land is duly in use, and from the ordinary routine of farming. The arable portion of the farm must be arranged as a farm in miniature, producing wheat for household use, barley for pigs and poultry—as will be afterwards detailed—oats for work horses and poultry, potatoes for the kitchen, poultry, and other purposes, and all other articles that are required for a domestic establishment in proportion to the extent of the capital that is invested, and to the arrangement of the one or two ploughs that are employed. A well-stocked garden is

also indispensable for the production of vegetables and the common fruits. An arable portion of land will thus be found to be an indispensable attachment to milk-farming in supplying wants, affording necessaries, and in giving some variation of employment tending to the general advancement of the undertaking.

It may be recommended that the work of arable cultivation of the lands for the confined space of the special plan may be done by spade digging, which will reduce or altogether dispense with horse labour, and with the keeping of those animals beyond one beast for the purpose of small or working details. It is certain that spade digging increases the quantity of vegetable growths beyond the ploughing of the land in furrows, and chiefly by placing the soil in open seams and cavities, and by piercing and opening the subsoil with the narrow points of the spade and of forks to allow the permeation of air and moisture, whereas the sole plate of the plough sledges the underground and shuts the orifices. The increase of produce may not in general practice reimburse the greater expense, which is very considerable, an expert spademan requiring twelve days to dig an acre of ground; and the great difficulty consists in finding a sufficient number of workmen to perform the diggings at the appointed time, and then how to employ them when no such work requires to be done. Market gardening is wholly performed by spade digging, because the purposes are small in extent and the requirements varied, and capable of regulated performance in single details. The purposes of farming are wholly different; extensive performances are required in a certain time, which, being done, a time intervenes during which no similar work is required. Hence it may be doubted if spade digging

can ever be used beyond gardens and limited extents of land that are favourably situated and require a special adaptation. The present general belief that the performances of the spade will not answer the purpose in large areas of land and for general cropping does not prevent the adoption of the tool in the, perhaps, more encouraging circumstances of a limited extent of cultivation, and in procuring the *force of* workmen that is necessary at the final times of performance; milk farms, being near to extensive populations, which will supply the workmen for digging without an engagement for constant employment, and the quantity of arable land being very limited, will derive the increase of produce from the spade cultivation without the objections that prevent its general use in large areas. Hence it may be safely advised that spade labour be employed on the milk farms that are now recommended, but without wholly dispensing with the use of horse-power for cartage and ploughing purposes; as the other general arrangements will be nearly alike in both systems of cultivation of the land, as may be preferred or rejected by fancy or from an ideal superiority, as the two arrangements may differ little.

It may be held as a maxim in the management of such farms or lands in cultivation, that all which require a greater strength than the power of two horses for the purposes of cultivation be used in a state of permanent grass, and in that condition to be improved and maintained in the highest possible state of production from top-dressings, manuring, and seeding, all to be done, when necessary, after the first improvements are performed. These lands will comprehend all the marine formations of clay in England known as the Plastic, London, Chalk, Lias, Oumah, and Kimmeridge

deposits, with the semi-fluviatile clay of the Weald, and with all the stiffest deposits of Scotland and Ireland. But the classes of soils so treated may be strictly confined to the marine formations, of which the most obdurate and viscous in the texture are capable of being sundered, disintegrated, and reduced in these properties by the action of lime. After this effect is so produced the land is heavily manured and seeded for grass, and being regularly and constantly treated with top-dressings of animal and vegetable matters, a new sub-aerial stratum will be made, which, being mixed with the sub-soil, will form a new soil of the loamy designation that is much improved in quality. To effect this object, the spade-digging of land may be of value in affording the means of placing the soil and manure in the best state of contiguity, and leaving the land open and interstitial to the permeation of air and moisture.

A full-sized kitchen-garden, of one-third to one-half of an acre in extent, is attached to each farm for the purposes of growing vegetables in the necessary quantity and variety for domestic use in the early growths till the later articles are got from the fields, as potatoes and beet. This provision is an absolutely essential adjunct to any living habitation, and in the higher stages of society there is required a compartment in addition for fruits and shrubs of the most useful kinds, and also an orchard for the fruit-bearing trees of the best utility, and all in the proportionate extent of the capital that is invested. There is no greater inducement to the leasing or the purchasing of lands than a highly enriched source of vegetables as the foundation of domestic use, and of small fruits for secondary purposes, and of large fruits in store. The dwelling-house

and its adjuncts may be highly finished and in every way commodious in the kitchen department, but there is wanted the early and ample supply of the articles of use, without which all other provisions are of little estimation. In the examination of lands to be used for the employment of capital, the domestic provisions must ever hold a chief consideration.

As before observed, sub-soils of any description may be converted into land of a fruitful quality by deep digging and constant manuring with animal and vegetable substances. This result is shown, not only in soil proper, but on soft rocks of any description.

Deep Culture of the Soil.

It is impossible to overestimate the importance of the deep working of the soil referred to in the text of our author; not merely to admit of the access of the atmospheric influences to the lower strata of the *arable* or working bed, but to open up the subsoil to the same beneficial agencies, and by thus gradually getting rid of such conditions as may be present in it, opening up a fresh and almost inexhaustible source of mineral or inorganic constituents of which the plants will readily avail themselves by striking their roots deep into the weathered and more or less completely pulverised soil. Deep culture of the soil, to use the expression for some time used after the system had been widely advocated, and to a large extent still so, met with many opponents. These based their opposition to the plan or system on the ground that, while the arable bed of soil or upper strata under ploughing and cropping was in good "heart" or condition, this would be greatly and for long time seriously injured by bringing up the subsoil to be mixed with or to lie in lumps more or less crude and bulky in contact with the upper soil. This objection was perfectly sound and good in cases where it was proposed, as was frequently done in the earlier stages of the system, to bring up the subsoil at once and then mix it with the upper soil, without reference to or before any close investigation had been made as to the quality of the subsoil: bad or good it must be brought up to the surface. But when

further experience and a more painstaking inquiry had been made into the subject, and it was proposed that the subsoil should be so operated upon that it would be gradually weathered, so to say, and ameliorated by atmospheric influences, and thereafter brought up in small quantities to be mixed with the upper surface, the roots of the crops meanwhile being thus enabled by the breaking up of the subsoil to descend into it and avail themselves of the inorganic constituents in which it abounded—then the objection to the system was at once met and set aside as in no way influencing the subject. Dealt with in this way, the subsoil and upper or working soil were treated separately, yet a bond of close union was nevertheless established; hence the system, in place of being distinguished by the name of deep culture, has been proposed to be called deep *stirring* of the soil and the subsoil. This last title has been adopted by many, and it is likely will ultimately be the universally accepted title, for it is definite and precise, whereas deep culture is somewhat vague, inasmuch as it may involve the plan of stirring, bringing up to the surface, and inverting it, in precisely the same way as the upper surface of arable land is cultivated by the plough; or it may involve the one operation only of stirring the subsoil so as to allow the air to penetrate it, pulverise it, and open it up for the access of crop roots to its inorganic or mineral treasures. We thus see that there is something more than a mere difference in name involved in this change of nomenclature; it indicates a special system of working clear, definite, and precise.

This deep stirring of the soil and the subsoil bids fair, with the help of the steam-engine and the mechanical aids to which presently we shall draw the reader's attention, to revolutionize the working of our soils, more especially those of a close and heavy character. The necessity for something being done in this way was becoming clearer and clearer in view of the fact that the upper surface or working soil which bore the crops was yearly becoming more and more deprived of those mineral constituents so essential to their well-being, but of which the very same crops served to rob them, so to say. To replace those constituents thus lost, large and still larger applications of manure, farmyard or artificial, were demanded and required—an expensive and in some respects not altogether satisfactory

way of restoring the balance which had been so markedly disturbed. But when chemistry and its suggestive lessons came to the front and showed the richness of the subsoil, lying so close beneath the exhausted upper soil, in those very inorganic or mineral constituents of which the upper soil was yearly becoming more and more destitute, the question began to stir in men's minds who thought at all on the subject—Is there no way in which we can bring up these mineral treasures and mix them with the exhausted soil? Hence came up the system of deep culture, which was applicable either to the bringing up of this subsoil or not to the surface.

But, seeing the evils above hinted at that might arise from mixing the subsoil in its crude condition with the fine tilth of the upper soil, the system of merely stirring the subsoil was proposed; this, in place of bringing its constituents up within reach of the crop roots, allowed the converse to be carried out, by which the crop roots went down to the constituents. The difficulty, however, now assumed a mechanical aspect, for while the majority were agreed as to the benefits of stirring the subsoil, the point was, By what power can we go deep enough to do this, and if the power be got by what implement? Horse-power, with certain implements, did good work up to a certain depth, but beyond that, so rapidly did the resistance increase, that it became a practical impossibility to go deeper by horse-power, however applied. To overcome the difficulty, the late Marquis of Tweeddale, to whom agriculture owes so much, adopting the principle of "divide and conquer," used two ploughs, one to plough in the ordinary style, but to take a much deeper furrow than usual, this being followed by a subsoil trench-plough of a peculiar form, which went still deeper, stirring the subsoil, but not bringing it to the surface or mixing it with the upper furrow-slices. Admirable as was this system in its results on the farms of the Marquis, for one reason or another it was almost wholly confined to these, being very little used elsewhere. Many attempts more or less successful were made chiefly by the makers of steam-cultivating implements and machinery, but it was reserved to the Messrs. Fowler of Leeds, the well-known steam-cultivating engineers, to establish and perfect a system, to which we have already alluded, as being likely

to revolutionize the working of our soils, especially the heavy classes. The implement by which this is done is designated a "patent knifer," from the tines being somewhat knife-shaped. These are placed on the well known balance frame of the firm, and are so situated with relation to each other that the whole area of subsoil which the united tines or knives cover, and to a depth of from two even up to the astonishing one of two and a half feet, is thoroughly broken up, and cavities of greater or less extent, according to circumstances, formed in the subsoil. There is thus a perfect and complete series of passages leading from the external surface of the upper soil down to the subsoil to the depths above named, by means of which the atmospheric influences are enabled so to reach and to operate upon the mass of subsoil as gradually to pulverize and weather it, that it will in course of time be fit to be mixed with the upper soil. This mixing the Messrs. Fowler do by means of a "subsoil plough," which works in conjunction with the "knifer," this plough bringing up small portions of the subsoil and mixing them with the upper soil, and laying the whole over in furrow slices, plough fashion.

The full powers of the atmospheric influences as pulverizers of subsoils are scarcely understood by farmers as a body, and the advantages of more than one kind are by many not altogether believed in. But beyond a doubt they are powerful pulverizers of the subsoil, and not only this, but they act as powerfully in ameliorating it, getting rid of its crude and often sour condition, and acting as the vehicle of what may be called aerial manures. So powerfully do they operate in these ways, that some go the length of saying that soils and subsoils so treated will require but rarely, in some cases never, any supplies of farmyard or artificial manures. Without going thus far, it may be stated, without fear of scientific contradiction, that the system will tend, and has been found to tend, powerfully in the direction of saving ordinary manurial applications to a large extent. Nor need this be wondered at when we consider the enormous supply of those very constituents for which our crops have been so long languishing which is contained in the subsoils of nearly all our farms. The whole is an illustration of the well known fable, "Dig deep, the gold lies low." (See the vol. in this series on "Farm Labour" for some remarks on this important point.)

CHAPTER IV.

BUILDINGS FOR MILK FARMS.

THESE farms now under consideration must be provided with a respectable dwelling-house for domiciles, in which the proportion of capital that is invested will direct the extent of the accommodation as in other classes of society. Two floors are required for sitting and sleeping apartments, a length of two rooms with a central passage, and a width of two apartments of the ordinary size. Back apartments are necessarily of a low height and small dimensions, to lodge the articles of daily use and the things that never should be seen. (See Plans and Elevation, Figs. 1 to 3 inclusive.)

The old English style of building is adopted with weatherboard gables and projecting eaves, which adds very little to the expense, and contributes a pleasing effect in deviation from a uniform routine of bare walls, with a pinched projection of roof. An adoption of this style, of plain execution, would do much to adorn any country, and always with a strict attention to convenience and domestic employments, for beauty vanishes when utility is fled.

The length of the *dwelling-house* may be in fifty-six feet over walls, affording two front rooms of fifteen to sixteen feet in length and fourteen feet in width, with a kitchen and sculleries behind. A central passage of seven

or eight feet in width leads from the front door to the

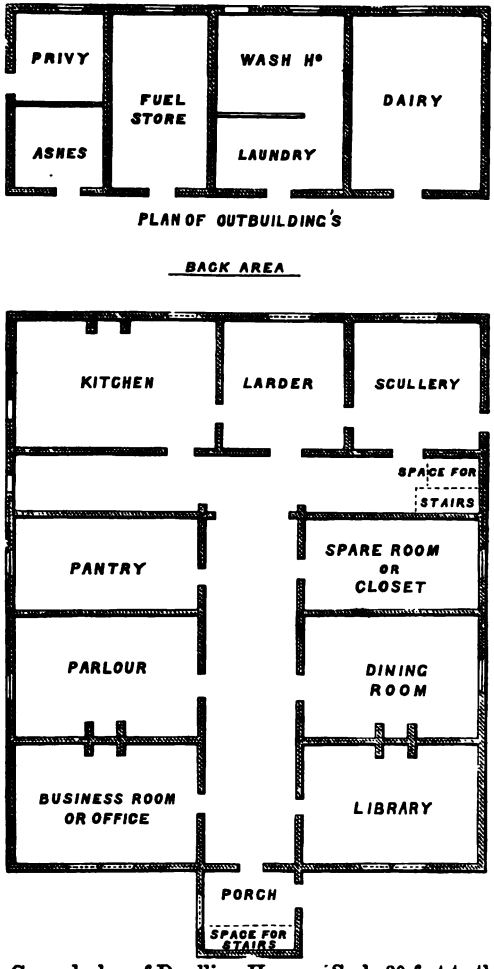


Fig. 1.—Ground-plan of Dwelling House. Scale 20 feet to the inch.

back premises, giving the landing-room for the stair to

the second floor. The height of the side wall is twenty feet, allowing eleven feet for the under floor, and nine feet for the second floor, which is divided into three or four bedrooms. The stair lands at the central window in the front, and a trap-ladder rises from the

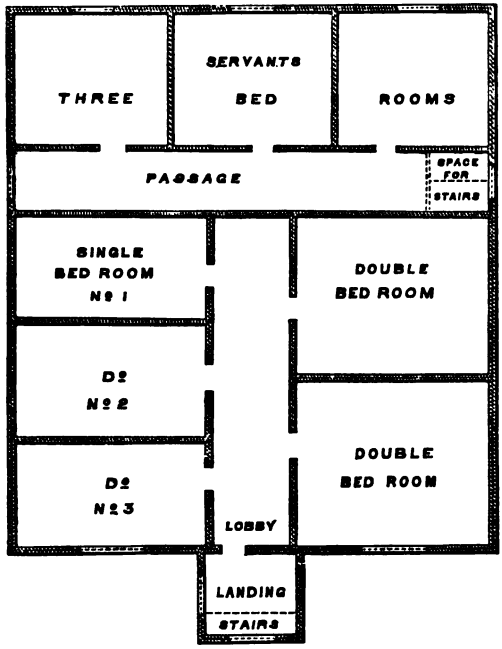


Fig. 2.—Chamber or Second Floor of House in Fig. 1.

kitchen to a bedroom over it for the female domestics. The windows in the side walls to be of the large diamond panes of glass, to correspond with the style of the roof, which is formed by two gable fronts before and behind the house, and in the gables also, of plain weather-boards and an upright pole (finial). The front door is

in a porch of the same structure. The roofing of the house is done in slates, and projects over the walls in a common extent. The flooring of all rooms is done with deals, the kitchen and sculleries with flooring-bricks; the painting of doors and windows is done as usual with the paper-hanging of the rooms. The necessary furniture of firegrates and wooden utensils is provided along with the house in all fixed articles.

It would add to the exterior appearance of the dwell-

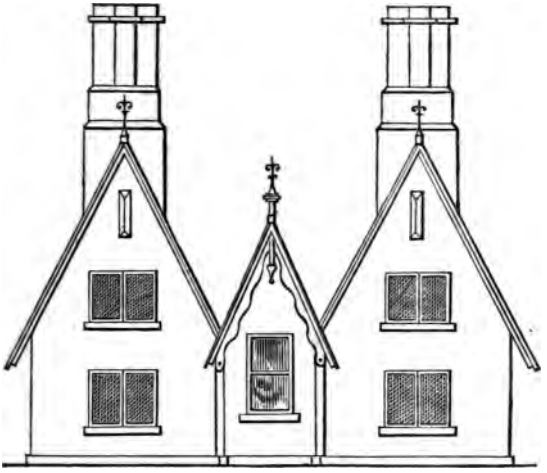


Fig. 3.—Front Elevation of House in Fig. 1.

ing to have a garden of flowers in the front of some yards in width from the walls, and to have these covered with creepers. The house may be placed in a corner front of the kitchen garden, with a strip of ground in front of it, one gable end wholly open to the convenience of approach. These positions will be much regulated by the surface formation of the ground.

The back area with the small buildings is placed at a little distance from the house, with which it agrees in length, and is of a height of eight feet in the walls, with a width of twelve feet in the ground floor. The length of the house is in five divisions, containing a fuel-house, a tool-house, a washing-house in the centre, an

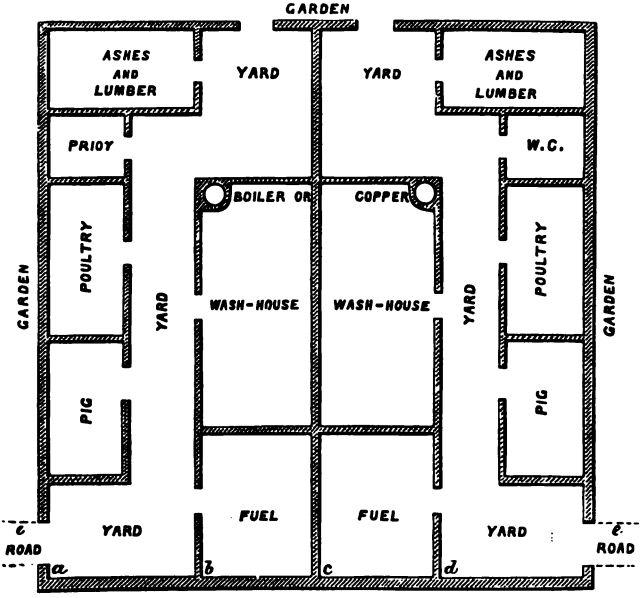


Fig. 4.—Plan of Outbuildings, detached or joined to House, as shown at *a b c d e* in Fig. 5.

ash-pit, and a privy. The water-pump will stand in the open area, and will send water to every necessary place in the farm establishment, merely by shutting the upper valve by a screw-nut over it, to force the water along a pipe from the interval between the upper and lower valves. These provisions are essential to every employment of rural labours in combination.

The erection of *cottage dwellings* (see Figs. 4, 5, and 6) on farms of land for the labourers is equally demanded with the provision of a dwelling-house for the farmer, as both agents are equally and essentially

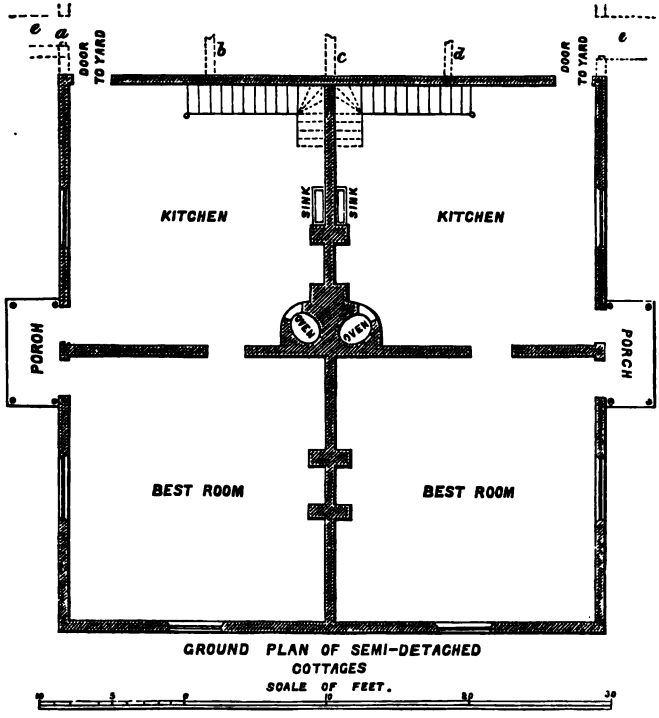


Fig. 5.

necessary for the purpose of performing the respective portions of the duties that are required to be done. The labourer must be near to the place of employment, in order that he be not tired in walking to and fro from it. A corner of land on the jutting side of a

field may suit for the location of cottages, with gardens attached of one-eighth part of an acre in extent, with an apartment for fattening two pigs in the year with its produce, along with a quantity of potato-ground, forming a part of the yearly wages of the labourer

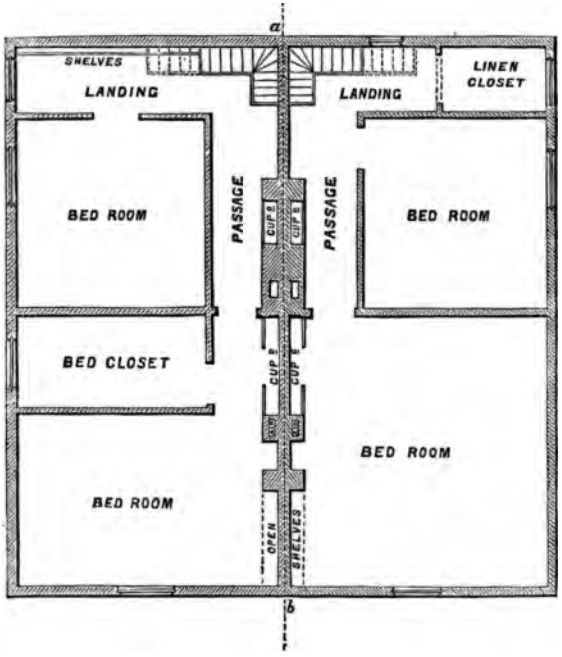


Fig. 6.—Bed-room Plan. Alternative Arrangements on each Side of Line *a b*.

in a value of money, the root being the most valuable for the fattening of pigs, and scarcely of less estimation for the use of human beings. A cow is kept as part of the wages, and valued into money, its produce forming a most essential article of provision for a healthy family, and along with potatoes, and chiefly

with a flitch of bacon filling the cottage larder, does more to prevent marauding and poaching than all the penal statutes that ever were written. Three provisions are required in the construction of cottages—two apartments on the ground floor for sitting and cooking; sleeping apartments on a second floor; and at least three in number, and some small apartments for minor purposes, as for fuel, ashes, tools, privy, and a pig. The two last apartments and that for the ashes may adjoin, with the privy in the centre, of which the contents can be discharged to either side alternately by a glazed pipe and a stream of water, and thus form a very rich mixed manure. The plain old English style of building is used, and the floors, doors, windows, and roofing are done as has been described in a former building.

The *farmery or steading of houses* for the accommodation of the animals that are maintained for the purposes of profit and labour must lodge the milch cows in stalls and loose-yards, all of the proper dimensions, and also the furniture of the arable lands in horses, pigs, and poultry in the small numbers that are required, with a steaming boiler to prepare a juicy food of roots and chaffs for the cows, of roots for the pigs and poultry, to impel the machinery of two-horse power to thresh the small quantity of grains that are grown, and, by means of conducting pipes, to warm the poultry houses and pigsties beneath the floors; and to drive knives to cut into short lengths the hays and straws for the purposes of chaffs and litter. These several and most necessary purposes are very useful applications, and diminish the small expense of the steam apparatus by the number of the points of utility all served by one agent. The cowsheds are placed in a longitudinal square, of a double width, in stalls, with

loose-yards on the sides of the building, and some few necessary adjuncts. The plain old English style of building is adopted in every case, moderately ornamental with a small expense, and not in any point affecting the convenience of the erection. The small farmery stands across the width of the cowshed, in order to prepare the food of the cows in a convenient position for being conveyed into the feeding-troughs. (See Figs. 7 and 8.)

The cowshed is one hundred and twenty feet in length, and forty feet in width, over the walls, which are eight feet high, containing two rows of double trevises, which hold two cows in each, and tied by a neck-chain to a stake on each side. The trevises are divided by posts and boards in a length of eight feet from the head to the tail of the animal. The two widths of twenty feet each cover the two rows of trevises, and present two fronts of weatherboards and poles in the old style to the south front, resting on centre pillars of wood. Four feet of width are required for the feeder's walk, eight feet for the length of the animal, and four feet for the dung channel, leaving six feet for the centre railway that conveys the milk to the depôts of sale. Alongside of this railway strong wooden pillars are placed to support the longitudinal beams on which the slate roof is rested, making a small pointed roof in the centre of the building in the width of six feet, which will present a neat appearance in the southern elevation. The roof of this central narrow length must be made of glass, to admit light to the railway underneath. The paving of the shed may be done with bricks or shaped stones—asphaltum is too slippery for the animals' feet to tread upon. Portland cement concrete is free from this objection, and forms the best floor material yet intro-

duced; cheap, impervious to damp from the soil below, and when washed equally so from the moisture above, and the necessary drains or channels can be formed on its surface with great ease. Two doors will be required on each side of the building for admission into the open yards, in which a portion of the cows consume the green food of summer, protected from sun and rains in narrow sheds of a light roofing, ample food being placed in movable cribs in the yards, with a litter of short straws on a dry lair over a stone bottom. The dry provender of the animals is placed in racks before the heads of the cows, and close-pitched troughs of brick on the ground on the opposite side of the rack receive the juicy food of steamed chaffs with roots; these require frequent cleanings, that are done by a stream of water rushing along the troughs, placed with a full stream from a pipe at one end of the building. The walk of four feet in front of the animals admits the convenience of feeding without disturbance in their lair. A channel in the walk of four feet behind the animals receives the dung, which is carried away along the channel, and is best to be immediately applied as a top-dressing in a fresh condition, as the fermentative decay of putrefaction for the purpose of manure is wholly disapproved. When there is not any grass land to receive the dung, a shallow heap may be made.

The attached buildings are intended to contain the produce of the small portion of arable land, the hays and grains, and a lodging for the animals. A steam apparatus prepares the chaffs and roots as a mixed juicy meal, which is carried to the troughs at the heads of the cows by light carriages on the railway along the side walls, and placed in a close trough of bricks or stone. One meal daily is the least that is given.

Steaming-vats and cooling-troughs are placed around

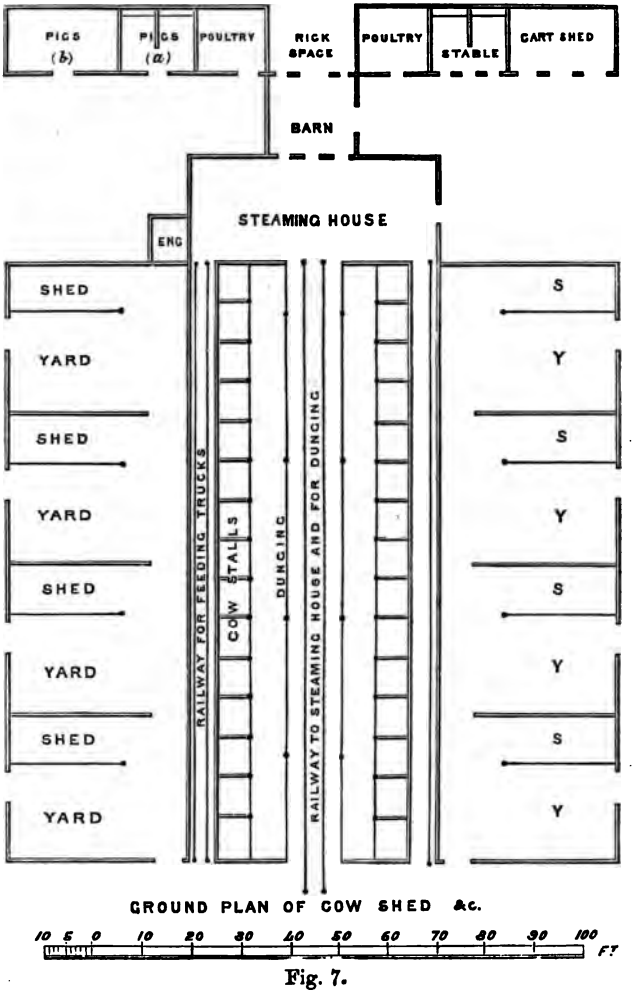


Fig. 7.

the walls of the ground floors, to which the chaffs are

sent from cutters impelled by the machinery, which may be of two-horse power and of quick action. The hay and unthreshed grains are supplied to the second floor of machinery from an open passage behind, and fall into the steaming house cut into lengths for chaffs and litter. Another width of houses contains a stable, with two pigsties and two poultry-houses, all on a small scale. Pipes from the boiler will convey steam underneath the floors of the poultry and pig houses to afford a warmth, which will be very beneficial to the latter animals, and induce the laying of eggs and the hatching of chickens of the poultry throughout the

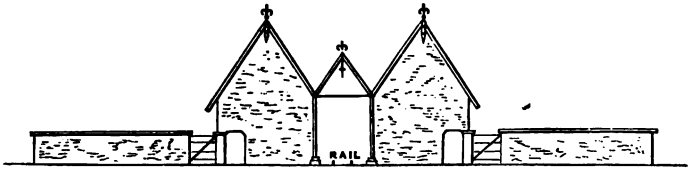


Fig. 8.—Elevation of Cowshed in Fig. 7, with Central Part in Section.

year. The entire system of the machinery can be put in operation simultaneously in threshing the grains, in cutting the chaffs, and in warming the floors of the houses; or each purpose may be performed singly by opening or shutting the pipes that convey the steam to each place of action. This convenience is very valuable on any farm with arable lands, and fully repays the expense of the erection from its being applied to several purposes, each of which contributes a share of the amount of the original cost. And so with all implements or tools that possess the property of a varied application.

CHAPTER V.

CHOICE AND PECULIARITIES OF THE BREED OF MILCH COWS.

THE selection of the cows which yield the produce of a suburban milk farm, is a point of the most primary importance, giving place to none in the value that is attached to it, forming as it does a chief element in the success of the institution. Milk being the sole article of produce demands the first attention, and the intimate consequences existing. Food and climate exert much influence on all organic life, according to the quantity and quality of the food that is used, and on the peculiar circumstances of the latter. An equal portion of the food for the special purpose must be attributed to that constitutional organism of the animal for producing largely milk or flesh in a greater or less quantity, which properties are found to differ very much in the various breeds of animals, and also among the single individuals of the same parentage of the male and female progenitors. The natural adaptation is found to baffle every choice of breeding, and all attempts to perpetuate it are unable to limit the extent. The freaks of nature are beyond any fixed control. But the unerring results of observation and experience advance their claim to direct the principles of application, and when steadily entertained and properly used, no great blunder will happen, unless conceit and igno-

rance usurp the dominion of sense and judgment, which should arrange and direct mostly all the plans and schemes of human performance. Without these qualities, of the first utility, all other acquirements will only act to mislead.

At this present time the best milking animals are found in the old breed of cattle in Yorkshire, which has long maintained an eminence among the breeds of cattle, and have afforded the foundation of the most celebrated variety of modern breeds, in the gaudy colours and splendid frames, both qualities diverging into many appearances, but still retaining the natural elements of superiority. The unimproved condition has been observed to produce a larger quantity of milk than the improved variety from a directed sexual intercourse based upon observation of the natural progeny. In proportion as the fleshing qualities have been promoted the milking property has been reduced, as is very evident from the appearance of the animal —a sufficient contradiction to the many opinions and statements that have been published on the subject. This is a property, not a quality, the former being permanent and persistent, and obvious to the exterior senses, the latter being adventitious and contingent, and must be discovered by various applications. Mostly all lactiferous animals inherit this property, which is probably most apparent in the cow and in brood sows. All terms of breeding in sires and dams, in pedigree and descent, and in the refinement of the organization, and experience has most satisfactorily shown that the refinement contributes to the production of flesh, and correspondingly reduces both the quantity and quality of the milk. The fleshy animal is rounder in the barrel and in the bone, deep and heavy in the

fore parts, and wide on the back and in the twist. The milch cow is wide and deeply set in the hind parts, milk vessel deep and square, with distending teats and large veins of the milk supply, bones of the body flat, and the frame rather angular, fore parts light, neck long and thin, head long, and tapering to a narrow muzzle. Round bones and flat pillars of the body are each a distinction between flesh and milk. At the same time the milch cow must have the aptitude in a fair degree of carrying the quantity of flesh that is necessary to establish and maintain a healthy condition for the support of the functions of life, without which the desired article of milk will not be obtained, as the one quality cannot be pushed into an extremity without a very hurtful effect on the other. But as milk is the chief object, the encouragement of it must be granted even to damage the other quality, though in a seemingly unequal portion.

Besides the recommendation that has been given of the old breed of cows in Yorkshire, there is found a very wide field of selection in almost every fair in the kingdom open to all persons that are capable of exercising, from observation and experience in the knowledge of cattle, the necessary judgment to discern the qualities that are required, and to draw comparisons that may be useful. It is pleasant to behold a herd of animals alike in colour and in size, the fashionable colour being red and white, in the ratio of mixture of three to one, with the many variations that are constantly occurring from propagation, keeping, culture, and from accidental circumstances. A complete sameness of appearance may not be attainable, nor even a very close similarity; but with a due attention directed to that point an approach may be made, which is as

much as can be got in many attempts of a similar nature. An average individual size in an assemblage of animals is much to be desired, and shows a refined taste in business, which is ever advanced by the use of the faculty of knowing the points of a good beast. But the milking quality is the chief consideration, and it may obtain very easily the foremost position, and yet the above qualities be at the same time admitted. By exercising a proper care in the selection, any farmer may possess his own herd of animals thoroughly fitted for the peculiar purpose, by attention to the special properties in the propagation, maintenance, and general treatment. Cattle, sheep, pigs, and poultry are all subjected to this special improvement for the attainment of particular purposes.

It has been observed, and experience has confirmed the fact, that animals of small size, or at least of medium bulk, yield a milk of superior quality over that of a large gaunt animal of an ill-shaped angular frame, with milk-vessel and veins very widely distended, showing a large watery secretion of fluid. Polled cattle yield a less quantity of milk but of a superior quality over that of lofty-horned animals, with more beef on a smaller quantity of bone, but of an inferior quality. For the sole purpose of milk of the best quality and in a fair quantity, select animals that have horns in a moderate length, the carcase round but rather inclined to thinness than to a fleshy thickness, and high rather than low on the leg. These facts are worth remembrance.

Breeds of Dairy Cows. The particular Purpose for which Dairy Cows are selected.

The subject of the breed of dairy cows is one of great importance, and requires to be considered in all its aspects, as some of these influence in a marked degree the results

obtained in practice. Although the remarks we are about to offer for the consideration of the reader are brought in under the present section, which is confined to points connected with farms which produce and dispose of milk only, much of what we give may have reference to the other sections of the work, in which dairying in its fullest sense is considered as a source of butter, cheese, and whey, in addition to milk. This is done not merely for the purpose of securing concentration of information, as well, perhaps, for that of convenience of arrangement, but because the various practical points of the subject are so mixed up or involved with one another that it is not easy to separate them; or at all events it is more convenient to consider them at one time. This much is necessary to be said, as the reader, when he comes to consider the wider and more general subject, will be provided with information on many of its details, and it will further explain why these are treated of here.

In taking up the subject of cows to be selected for dairy purposes, the first essential to be considered is the purpose for which they are to be used. This would seem to be such a very common-sense point to consider, that we could scarcely fail to be convinced of its importance, and give it our most serious consideration. But it is only a bald statement of the truth when we say that on many farms cows are bought with no very clear ideas of what they have been bought for; or, perhaps, the correct way to put the point would be to say that they have been bought with a vague idea for a certain purpose, but without even endeavouring to ascertain whether they were likely to serve its aims and gain its ends. That cows, like all other animals, will afford in the peculiarities of their physique, if the expression may here be allowed, indications that they possess certain qualities is beyond all doubt indisputable, for it is an axiom in the production, so to term it, of our domestic animals, that as we breed so we get certain characteristics. Yet, nevertheless, many who ought to be and are deeply interested in the inquiry as to what these indications are, and whether the qualities which they prefigure are likely to serve the end in view, pay little or no attention to them. Some, indeed many, have what may be called an intuitive ability or faculty which enables them to decide off-hand the cow they wish, as readily as a thoroughly experienced cattle salesman can,

by merely walking round and looking at a "beast," tell to a pound or two his dead weight sinking offal. But this presupposes that such know what they want—a very likely thing with such men; but it is just this want of knowledge as to their requirements, or indifference to them, on the part of so many, that we are at present alluding to, and which, of course, we cannot too strongly condemn.

In dairy cows there are three leading points, one or more or all of which dairymen may aim at securing in the animals they purchase: first, a capability to give large, or the maximum, supplies of milk, without reference to its quality; secondly, as yielding milk of good quality, rich in butyraceous constituents; and, thirdly, a tendency to fatten quickly after being "dried off," or no longer used for dairy purposes. The last peculiarity may be combined with either the first or the second, or the first may be combined with the second; but the three cannot, however much some might desire it, be met with, or are not at all likely to be so, in the same animal.

Where the milk is sold off at once, as in the case of the "milk farm," which forms the subject of the present section, the object with some dairymen is to get quantity wholly irrespective of quality. At first sight it may appear to be good policy, inasmuch as a large return is obtained from the cows, the quantity yielded by them being the measure of their paying capabilities. Nor will the practice be one likely to come across or call out the punishing powers of the Adulteration Act, now so stringently enforced in many districts, inasmuch as, although the milk be poor, it is not so in the sense of being adulterated; it is good and true milk so far as it goes, poor but pure, no intermediate dealing or "doctoring" of it coming between the cow and the purchaser. But good commercial policy though it may be considered by some, and although not trenching upon moral ground like the dairyman who sells watered or doctored milk, still it is, after all, but poor policy in the long run. The public soon find out poor milk, however sound it may be in one sense; and poor milk is always dear milk. And although, in the case of large towns, milk as a rule is so difficult to be had that families will in many cases put up with what they know to be of poor quality rather than be without, glad to have, in fact, what they know to be poor, but poor

from natural causes, and not bad as well as poor from being adulterated; still, as a rule, the dairyman who becomes known as one who sells milk of really good and rich quality will be sure in the long run to get such a trade, or "connection," as it is called, that purchasers will gladly give a higher price for his produce than they would do in the case just above considered.

The Policy or otherwise of considering Dairy Cows as Fattening Beasts for the Butcher after drying off.

Taking it for granted, therefore, that the honest, the best and wisest, because the truest system will be followed by those who purpose to engage in dairying, we have to consider the points which indicate cows capable of yielding the best and richest quality of milk, and at the same time to see if it be possible to have those which will also give large quantities of it. And here comes up the point as to whether it is wise policy to attempt to gain the third advantage or peculiarity in dairy cows; namely, that which will enable them to be so fattened when dried, that they will bring a good price from the butcher. At first sight this would appear to be a source of double profit; but it may, however, be purchased at too great a cost. For in order to enable a cow of a good milking breed to keep giving her maximum quantity, it is necessary that she ought to be fed with this one object only in view, not for the purpose of fattening her: any or at least a close approach to this will assuredly lessen her milking capabilities. The whole details of the management of dairy cows turn upon this one point, keeping up the yield or quantity and the quality of the milk; and granting that a breed is obtainable which at one and the same time possesses the aptitude to give the maximum yield of milk, and to fatten well and quickly when she ceases to be used for milking, it is even then, to say the least, doubtful whether the fattening will cost more than it is worth. It need scarcely be pointed out here that for fattening stock, the best results are quickest obtained with young animals at that age when they have all their physical powers in the highest stage of vigorous development. But cows of a good milking breed go on milking, and yielding largely all the while, till they reach

an age which entitles them more to be styled aged than young animals. But as fattening is a process which calls upon physical properties different in many respects from those required to promote milking, and as the whole details of feeding and management are different in consequence, the cow when she is put to fatten after being dried has reached the age when those powers—such as they are—will have lost a great deal of the vigour and energetic action possessed by young animals, and this even should the animal have in addition to her milking even high fattening capabilities. But these, as a rule, the cow does not possess, as may indeed be at once known by remembering that she is a female; all her physical organization goes to the development of other qualities, enabling her to fulfil functions wholly different from those of the fattening cattle, which are generally and for obvious reasons males, the female being retained for dairy purposes. Nor should it be overlooked that the cow, having had all the drain upon her functions which maternity demands, is thus also further reduced in physical power. Besides, the mere change of system of feeding and management must exercise an influence more or less marked on the fattening powers of the cow. But even granting that many points, physical and physiological, be in favour of the cow being a good fattening beast, it must be borne in mind that there is even in the fattening of cattle which are designed throughout their existence to be reared for the shambles such a very narrow margin of profit in many cases, that it is doubtful whether it pays—assuredly in many instances it would not pay if the manure produced was left out of account. Now if this be the case with animals with everything in their favour as fattening beasts, it will be seen that, to say the least, the value of the system of fattening off dairy cows is very doubtful, and we should say decidedly so if, to gain an aptitude for fattening, some of the qualities in which good and abundant milking are sacrificed. Upon the whole, then, we are inclined to decide that the safest system will be to value cows only for their milking properties, and to sustain those by a system which will keep up the maximum product of milk, with at the same time a fair state of "good condition"—not fat—of the frame, so that a moderately good price will be obtained by selling her when she is dried off to the butcher, the sum

so obtained being best looked upon as something extra, or as supplementing what has been got from the animal as a milker, and that she be able to perform all her necessary functions healthily andwell. Taking this view, let us glance very briefly at those peculiarities which experience and observation have shown to be indicative of cows likely to yield milk not only in large quantity but of good quality.

The Milking Capabilities of Dairy Cows influenced by their Food and by certain Physical and Physiological Peculiarities.

While there are points which largely influence the milking capabilities of a cow, and which we shall presently take note of, these again are greatly influenced by the food upon which they are fed, and this by the physical organization of certain parts of the body; for, as is well known to observant feeders of all kinds of live stock, the same kinds of food prepared in the same way, and given precisely at the same time and in like manner, will produce quite different results in different animals; one taking kindly to and making the most of its food, whether in the way of producing fat and flesh or of milk, while another will scarcely thrive, let alone give anything like a paying return for the food consumed. It is not always easy to define the peculiarities of the animal which lead to such different results, nor to predicate precisely in the case of different animals which will be a good which a bad paying one. Still, with all this uncertainty, there are fortunately peculiarities which are known to be indispensable in an animal, and although they may not always turn out favourably, it is certain that without them the animal will not be a good one. One of these is the possession in a dairy cow of a *large and well-developed stomach and bowels and digestive organs*. This is essential from what we have said as to the influence of the food of a cow on its milking powers. She must, therefore, have the capacity to take in large and frequent supplies of food, upon which her peculiar digestive organs will have full power and free action in assimilating. These peculiarities, or capabilities rather, give to the body of the cow an unusual extension towards the hind quarters, with a corresponding—if not always proportionate—narrowing towards the fore quarters. A cow looked down upon from above has a wedge-like form or appearance.

The haunch-bones project considerably, the pelvis, as is necessary for easy parturition, is wide; the hind legs are separated very considerably from one another, so as to give free space for the full development of the udder, on which important organism we shall have a remark or two to make farther on. The chine, if double, is looked upon as a sign or indication of an excellent milking cow. This duplicature of the chine is thus caused: in some cows the chine is uniform throughout its whole length, this being the case, as a rule, in cows of a mediocre or even a decidedly poor quality as milkers; in other cows the chine has a depression or hollow beginning about the centre of its length, but continuing backwards towards the hind quarters, or the rump, of the animal, towards which point the chine becomes double; this is the sign which is looked upon by many as indicative of the best class of milking cows, and is almost always accompanied by a great breadth in the hips, which we have already shown to be another sign of a good milker. The hind legs are separated pretty widely, the udder demanding a free space there for its full development. The depression here noted is said to be of the best size when towards the centre of the spine it has a width, caused by the separation of the spiral "processes" of the vertebral column, sufficient to allow of the two forefingers to be inserted, or say an inch and a half broad. In a cow of the middle class of milkers, as judged by this indication of the appearance of the chine, this is in a measure shrivelled up or wrinkled at a point about the centre of the spine. *Lungs not too largely developed.* While in the case of fattening cattle a large development of the lung or pulmonary functional space is considered a good point, in dairy cows, on the contrary, while of course sufficiently large to enable the breathing to be carried on easily and healthily, it should not be too largely developed, inasmuch as a too energetic respiratory system, which is the result of this, is apt to cause a loss of valuable constituents of the food, which, becoming rapidly exhausted, causes the animal to draw upon the food for the purpose of making up for the waste, in place of going to the production of milk. A quiet steady state, or what might be called a condition of general repose in the pulmonary functions, is the best adapted for dairy cows. Hence cows of a gentle, placid, feminine, soft-like aspect, indicated by fine lines on the head and face, a

total absence of the "bull neck" cut or contour, and mild eyes, are generally good milkers. What may be called masculine looking cows should be, as a rule, avoided for dairy purposes. *The head should also have none of the bull-like characteristics;* it ought to be small and tapery towards the muzzle, so as to give it a length not met with in the short, massive, and heavy frontal development of the bull's head. The head of the cow should, while of this form towards the muzzle, taper or be narrow at the point where the horns are set on. These ought to be of a fine, clear, horny, and shining or transparent colour, and taper gently to fine points. The positions of the rings of these are indications of the age of the animal, but as they are not always clearly developed, indeed not often showing till the cow has reached her third year, and as, moreover, they are sometimes "manipulated" for dishonest purposes by unscrupulous dealers, they are not much to be relied upon. *The skin and the coat, or hair,* of the cow both afford good indication of the goodness of her constitution and the state of her health at the time of examination. The skin, when handled, ought to give that peculiar, soft, tender, yielding, yet firm, not flabby, feel which it is impossible to describe, but which to experienced hands is so well known, and designated as "the touch." The skin is not, from what is here said, thin, as some might suppose, but is rather thick, but it is elastic, yielding to the touch, and instantly resuming its position when the pressure is removed. The "coat," as it is technically called, should be of fine hair, thick and soft, having to the handling a feeling of warm eider down or moss, and be glossy, clear, or shining in texture.

The Scutcheon, or Escutcheon, indicative of the Milking Capabilities of a Cow.

The hair in a cow assumes at the buttocks a very peculiar appearance, which has given rise to a theory or opinion upon which indications of the milking qualities of a cow are supposed to be founded, and to which attention was particularly directed by a well-known Continental agriculturist, M. Guenon, who wrote a treatise upon the subject. Although authorities in this country do not accept of all the conclusions of M. Guenon, nor of the indications which he points

out, still the opinion is pretty generally held that the main principle is correct. As a treatise has been written on the subject, we can only be expected here, in our limited space,* to give but the most brief of outlines of its leading points. On looking at the hinder parts of a cow, the hair covering the udder and the parts of the body immediately around it, assumes an aspect quite different from the general hair of the body; one portion of the hair projecting upwards, the other portion projecting or pointing downwards, the point at which those two opposing lines of hair meet form necessarily a peculiar shape, or what has been called a "species of fringe," to which M. Guenon gave a name which is called with us the "escutcheon," or more popularly the "scutcheon." If this extends or spreads outwards laterally widely, so as to cover a considerable part of the thighs of the cow, she is said to be a good milker as regards quantity, this form of the escutcheon being a good indication of this; if the upper part of the escutcheon as above be broad, and the hair smooth, this is an indication that the cow will not only give a large yield, but that she will continue to do so for a long period; the opposite characteristics afford, of course, an indication of the opposite qualites in the cow. As a general rule a large escutcheon may be taken as an indication of a good milker, a small one, of a poor or indifferent one; but it must be observed that these indications must not be alone relied upon as determining the value of a cow as a milker; they must be taken into account along with other indications, the majority of which we have already described, and to the remaining ones of which we now beg to draw the attention of the reader. It is also necessary to state that the peculiar forms which the escutcheon assumes can only be made clear by stretching out the skin, as the wrinkles and natural creases, as well as part of the flesh of the thighs, conceal, cover up, or draw together the hairs which form it.

The Udder, Milk-glands, Milk-veins, Indications of the Value of a Dairy Cow.

The other indications by which to judge of the milking

* The reader desirous to gain further and full information on the subject may consult the *Twelfth* Edition of the "Complete Grazier," edited by the Editor of the present volume, and issued by the same publishers.

value of a cow are as follows. First, the *udder*. There are some erroneous notions afloat in the popular mind, and indeed even amongst those closely connected with dairying, who ought to know differently, which require to be noticed here. The first is this, that the udder is but, as it were, a large and single bag, containing thus but one cavity in which the milk is held, so that it is a matter of indifference whether the udder is properly supplied with teats, and those free and open, or whether the full number is absent or some of them "blind," inasmuch as one will do as well as another for drawing off the milk. Now this is the very reverse of the truth. The udder is made up of a series of what are called mammary or milk glands, these being placed at its upper part; usually, these glands are four in number, each gland being distinct from the other, and each being provided with its own special teat. Having thus no direct communication with each other, it follows that if any one has its teat absent, or that teat, although present, closed or "blind," as the technical phrase is, one-fourth of the milking capability of the udder is lost. Hence the importance of seeing that the udder has its full set of four teats, and the necessity to try each teat separately to see that it can draw from its own separate gland. And as the milking value, so to say, of the udder depends upon the proper development of the *milk-glands*, and as these should be large and full, it follows also that the udder or bag which covers or contains them must be large and well developed also. It should have its teats well and comparatively widely separated from each other, and those set evenly on and over its surface. The udder should be well placed upon the body of the animal, so that it goes forward well under the belly and extends well behind the legs. The skin should be thin and mellow and soft to the touch, and the udder when handled should not give a fleshy feel, as some udders look well developed and with a large capacity for containing milk, and yet are to a great extent but lumps or masses of flesh, with little mammary or gland development. In close connection with the udder is the last indication of a good milking cow we have here to notice, this being afforded by what we know as the *milk-veins*. These are placed one on each side of the animal under the belly, but rather nearer the sides; as they approach towards the head or front of the cow they

die away or are absorbed into the system, but as they approach the udder they are more or less full and distended. The proportion of their development varies much according to circumstances, but in good cows, at the point or angle where they join the udder, they show a dilated appearance, or what is professionally termed a varicose swelling. The milk-veins are looked upon by all good authorities as affording excellent indications of the milking powers of the cow; for they are the vehicles for conveying the blood, and, if large, they show that the process of circulation is going actively on, and therefore that the yield of milk will be good; if the veins are varicose, having a knotted appearance caused by the alternate swellings and depressions, or rather, perhaps, which may better be described as a wavy irregularity, it is also considered a good additional sign. The veins round and about the udder should also be well developed, as this shows the activity of the circulation; when this is languid, feeble, and unsteady, the cow is not in good condition, and cannot therefore give out her best qualities.

Variation in the Quality and Peculiarities of the Milk of Dairy Cows. Butter-making. Cheese-making. Milk.

But although the dairyman should pay all attention to the indications of the individual members of his herd, and although several may afford the same classes of these indications and about the same degree of equality in each, it must not be supposed that alone they will afford the data necessary for him to decide with absolute precision for which purposes the animals will be most valuable. The mere quantity of milk obtainable from each cow may be very similar taking a number of cows; yet while one can yield milk which is found specially valuable for butter-making, another will be as marked for its cheese-making milk. This peculiarity which is often found—and would be found, perhaps, more frequently, if dairymen were more in the habit of testing the milk, &c., &c., than they are—in a herd of cows the other general indications of the milking qualities of which, such for example as we have just described, seem to be pretty nearly equal, seems to have its origin more in or from the peculiar breed than from any particular quality of grass upon which they are pastured, or food upon which they are fed. In proof of

this, some recent and very extensive investigations into this particular point, entered upon by some scientific men and dairy "experts" abroad, show that in those districts famous for cheese-making the particular breed of cows there met with yield milk richer in caseine or cheese-making constituent than in the butyraceous or butter-making one; while in other districts, as famous for the butter which they produce, the breed of cows yield milk possessing properties the reverse of the above. It would thus appear that there are breeds which are best calculated for one class, others for another class of products; so that it may yet be a matter which, by the patient investigations of scientific and the observations carefully recorded of practical men, may form part of the work of a dairy farm, the classifying with a high degree of precision the cows which may be fixed upon as butter and those which may be set aside as cheese-making ones. This, indeed, to a certain extent, has been already attained by some dairymen of more than ordinary acumen and powers of observation, and in a few districts some breeds are known to be better adapted for one purpose than the other. There is, however, much yet to be done before the point can be considered as placed upon a scientifically and practically accurate basis. We name it here as indicating that a great number of considerations have to be taken into account before the dairy farmer can be said to know his business in a thorough way. And much after all must of necessity be left to conjecture where life, with all its peculiarities, has to be dealt with. There is a point up to but beyond which man, with all his knowledge, can go no further.

Disadvantages of buying Dairy Cows in Open Market. Advantages of breeding and rearing Dairy Stock on the Dairy Farm.

There is, perhaps, no cause which operates so powerfully in keeping down the qualities of the cows of a dairy herd as the habit or custom which so many dairyman have of buying their stock in open market or from neighbouring farms, without the slightest inquiry being made as to the animal's "pedigree" or her general peculiarities. When purchases are made in the open market this inquiry, no

doubt, cannot well be made, and if it were it would be almost sure to be met with a flattering reply; but in the case of purchases made from neighbours—not selling in the open market—such inquiries might be made with some degree of assurance that a fairly honest statement might be obtained in reply. But seeing the great importance to the dairyman of having stock of the first quality, the only true way to secure this is to breed and rear the cows himself. This will doubtless be a work of time as well as one demanding no small degree of care, and of what may be called critical acumen and close observation. More than this, in order to weed out the bad and so ultimately to have a herd if not wholly still moderately good, and which in valuable points will be increasing yearly, he will have to institute a thorough system of supervision as to what may be called the work, "behaviour," or doings of each particular cow in his herd, and not only this, but to record the results of this, so that by referring to his notes he will be able to trace for a somewhat extended period the peculiarities of each individual cow. This, as we have above said, will involve no small labour, but it will bring with it the high satisfaction of his being ultimately able to take a place as an eminent breeder of dairy cows. Nor will this be the only satisfaction resulting from labour of this kind, for it will bring as well the "golden gifts" of success in the high prices the dairy farmer will be able to demand, and which he will find no lack of purchasers ready to give him. This, as yet at all events, has been the regular and pleasant course of such a system, and in place of this being likely to be altered for the worse, indications abound around us to show that if alteration there be, it will be in quite the opposite direction; so steadily is the demand increasing for high-bred animals in all classes of live stock and in dairy no less than in others, and so also for their produce, which has for some time back steadily advanced in price.

Selection of Cows to breed from.

In carrying out the system of home breeding, the dairy farmer will have to begin with a selected stock. It will be much safer, as above stated, as a rule not to select from open market, but from the herds of his neighbours, or, if he can afford it, from some well-known and eminent breeders, upon

whose uprightness he can rely, so far as honest fair dealing be concerned, although they may as likely as not, at least some of them, be of that class who have not paid attention to breeding and rearing dairy stock. But be this as it may, the stock being selected to the best of the dairy farmer's judgment, aided in so far as possible by attending to the indications of good animals which we have already described, the work of weeding out must be begun at once.

Relative Milking Capabilities of the Herd of Dairy Cows.

The first step in this process is to ascertain the relative milking qualities of the herd so far as quantity is concerned only. This can be done by carefully registering the quantity by measure, or the weight by weighing, which each cow gives during the season. Each cow should be distinguished by a name or number; both indeed should be used, for a cow likes to be made of, and to be called by some "endearing name," which should be written in legible characters and attached to the travis of the stall, and also entered in a book with properly dated columns, into which the yield she gives is duly entered. If the herd be small in number, or if extreme accuracy be demanded, the yield may be registered every day, but in a large herd this may be too great a labour, hence it may be registered at longer intervals, and then the whole being reckoned up at the end of the season, a simple arithmetical process will show the yield with a fair degree of precision. Weighing will give more accurate results than measuring, although it takes a little more time. The quantity or weight of milk yielded by the various members of the herd being thus ascertained, the next thing to do is to ascertain the quality. We have already said that the milk varies or may vary as regards the constituents—cheese or butter making ones—but the determination of these involves processes too closely resembling the analytical work of the laboratory to be carried out in the dairy. There the only test of quality is the quantity of cream which the milk yields, to which may be added some rather rough-and-ready ones connected with the keeping qualities of the milk tested by the smell and taste.

Testing the Qualities of Milk.

The mere richness of the milk, so far as that is indicated by the quantity of cream which a given weight or quantity of milk produces, is readily, and for all practical purposes accurately, enough tested by the use of any of the ordinary glass drinking tumblers in use in the household. Of these, of course, the best are those which are of a diameter as uniform as possible throughout their length, and plain, not fluted or cut. The milk from each cow should be placed in its own glass, her name being attached to the vessel (gummed paper slips are very useful for a variety of purposes, both in the dairy and household work), and these being set in a quiet place and not disturbed will show on the cream rising, the quality yielded by the cow, which may be compared with that yielded by other cows of the herd the milk of which is treated in the same way. It is not generally known, or where known may be apt to be overlooked in tests of this kind, that the morning's milk of a cow is the richest which she gives in the course of a day. It will be necessary, therefore, to test the cream yielded by both the morning and the evening's milk; and as in some dairies, especially in the northern districts of the kingdom, the cows are milked at noon as well, thus giving three milkings in the day, this milk will also require to be tested for quality of cream. In order, then, to arrive at the daily yield, the cream of the various tests must be put into a graduated vessel, marked to indicate ounces and parts of ounces, and the result then entered into its proper column against the particular cow. In place of the homely testing appliances above named, a proper set of testing tubes, known as a "lactometer," may be bought at a trifling cost, and will be more handy and, of course, more accurate in the calculation than the tumblers or household glasses.

These tests may be made at intervals, according to the judgment of the dairyman; but it must be borne in mind that as the kind, quality, times, and mode of giving the food influence in a very marked manner the yield of the milk as against quality and its richness in point of quality, the different tests made, however numerous they may be, must all be made when the cow is under the same system of

feeding; and it need scarcely be added here that the cows which are tested against one another must also all be under the same system. Some very curious, suggestive, and often most unexpected results will come out of the tests as here described; thus it will be found that the quantity of cream will not always be an index to the weight and quality of the product—as, for example, butter—made from it; a cow which yields in its milk a lesser weight of cream than another being found to give a greater weight of butter.

And so also as regards the food, some very suggestive facts may be gathered, *if looked for*, from the results yielded by the tables. Thus it will sometimes be found that the system of food (the kind) and feeding, the mode of its preparation, and the time and way of giving it, will influence the yield both as regards quantity and quality of the milk; and not only this, but it may be found that a system which suits the cows one time will not suit them at another; nay, that what suits one cow will not suit another. To note all these details, and to draw from them suggestions which will be useful in practice, will beyond doubt take time. But this objection—if objection it be—holds equally against all other callings; and the most that can be said about it, and all indeed that needs to be said, is this, that if the best method of conducting a business—that which will make it pay—be neglected or not carried out simply because the doing so involves trouble and demands the giving of time, the business had far better not be entered into at all. This is such a common-sense view of the whole question that it cannot be gainsaid, and admits of no argument.

The details and tests being, then, carried out as we have indicated, data will soon be obtained from which the dairyman will be able to decide as to which are the best and the worst cows of his herd. The bad ones must be at once got rid of, and the best kept and subjected to a repetition of the tests and observations and deductions made therefrom, till of these cows the very best are marked out specially and beyond a doubt; and from these future cows must alone be obtained. In the matter of the bull with which to mate these good and carefully selected cows so as to obtain this progeny, the dairyman will have greatly to depend upon his neighbours who keep such animals for service; but he will of course take all due care to inquire into the pedigree of

the male, and if possible see and inspect him, to make sure that he possesses the points of a good sire.

By adopting this careful system—now here only very briefly described, for there are many points in it about which much could have been said—not only will the dairyman in time have a herd of cows which will be valuable for milking purposes and for sale, but he will be saved from all the risks —and they are as dangerous as they are numerous—incurred by buying in open market. Many a herd has been nearly swept away by disease imported into the dairy through cows which have been bought in open market in a diseased condition, either incipient or partly developed.

Treatment and General Management of the Calf.

There is, perhaps, no department of the management of the live stock of the farm about which there is so much diversity of opinion as the course which should be pursued in the earliest stages of the life of the calf. Some breeders advocate the nursing of the young animal by the dam from its birth till time of weaning; others as warmly advocate the system of hand-feeding wholly from the time of birth; while others, adopting a part of each system, maintain that the best system is that in which for a short period after birth the calf is weaned by its mother, afterwards taken from her and brought up by hand; and the advocates of each system can bring forward a pretty wide range of experience in support of it.

Passing these three systems briefly under review, we have to note that while we wish to present a fair, unprejudiced view of their merits, we confess to a strong feeling in favour of the first, and this for reasons as follows. Broadly stated, this system is much more likely to be the one best calculated to do the fullest justice to the animal in its earliest, and thus prepare it to be a first-rate beast in its later, stages of life, and this if upon no other ground than that it is the natural system. It is not merely, however, that because it is supported by experience and general analogy that we hold this view, but because there are certain peculiar circumstances connected with the relation of the mother to the calf, and that these bear closely upon the well-being and health of each, that we do so. Take, for example, the fact that the first

milk which the cow yields after the birth of the calf is wholly different from that which she afterwards gives in appearance, quality, and constitutional effects. The latter gives the first milk of the cow—known throughout the country by various names—that peculiar quality which renders it of such service to the calf, it having a medicinal or healthy effect upon its constitution. Hence one reason why it is a good thing for the calf to suckle its mother from birth. It may be said, however, that the first milk would have the same effect if given to the calf by hand, or rather the pail and hand. But this by no means follows; indeed it may be assumed as physiologically correct to say that the milk drawn from the cow by the calf by the natural process of suckling will be in some, if not in many, and these the most important, respects different from the same milk drawn from the cow by the hand-milking process, and allowed to stand in the air for a time greater or less. But, apart from this, the act of suckling by the calf has a beneficial influence not only upon itself, but upon the cow; for it exercises that gentle pressure upon the udder which is more beneficial than most are aware, and goes far to prevent milk fever, as well as from the way in and the frequent but short intervals with which the milk is withdrawn. Again, the body of the calf when born is covered with a slimy substance; now when this is licked off by the cow, it not only is the best way in which it could be done for the calf, giving that soft, warm, and gentle pressure which tends so well to set in motion the circulation of the feeble frame, but it acts when passed into the stomach of the cow medicinally, and has a very beneficial influence upon her at a time when this is most requisite. We have said that the licking of the calf by the cow is the best way in which it could be done; infinitely superior assuredly to that way when the calf is taken at once from the cow the moment it is born. This way of rubbing the weak creature down with rough straw is scarcely a natural one; and although well done, it is sure to leave the calf in a damp state, so that when put into its crib it is by no means comfortable. We have seen recently born calves lying shivering on the top of hard straw, a condition certain to produce bad effects. How different this from the warmth of its mother. But we have another beneficial influence to point out, arising from the system of allowing the calf to suckle its mother, and that is, its stomach is never overloaded.

If one watches a calf suckling it will be observed that it draws the milk in small quantities at a time, but at pretty frequent intervals—a method thoroughly and naturally suited to its condition, for of the various stomachs which a cow has only a part of them is used when a calf. We shall presently see how this natural system of taking food contrasts with the artificial system of giving food to the calf when fed by hand, which is the next we have to notice. Previously, however, noting this, that when the natural system of rearing the calf just described is decided upon, it is not always that it can be carried thoroughly out, that is, up to the point when the calf is weaned; and this from the fact that from various causes the mother may not be able to give the necessary supply of milk. Sometimes also, which is one of the vagaries of nature we cannot account for, the cow may take a dislike to the calf, and not allow it to suckle her; or, what is, perhaps, more strange, the calf may take a dislike to the cow, and not allow itself to be nursed by it. From one or other of these causes, then, the hand-feeding of the calf, the second of the systems we have named, and at which we have now arrived, must of necessity be adopted. Hand-feeding is so called from the fact that the calf, totally unaccustomed at first to drinking out of a vessel, has the milk given to it by its being laved, as it were, into the mouth of the calf by the hand of the dairymaid or the cowman. At first there is some difficulty to get the calf to take the milk, in which case a good deal of kindly patience and, if we may be excused the semi-pun, motherly tact must be exercised by the feeder, to coax the poor animal to take its food in this, to it, unnatural way. Perhaps the best plan is to dip the forefingers at first in the milk, and allow the calf to suck at it; afterwards a good plan is to allow the milk to be strained, as it were, through the fingers into the mouth of the calf, which is better than lading it up in the palm of the hand in larger quantities. The calf will soon learn to suckle away at the fingers of the dairymaid—a habit which, by the way, they become specially fond of exercising—until it gradually learns to drink its allotted portion itself out of the milkpail. Let it be noticed that the great point to be attended to in hand-feeding is not to allow the calf to take too much milk at a time; for, as already hinted at, the whole range, so to say, of the stomachs which when as a cow it will use, is not

used at first, when in a state of calfdom. It will thus be seen that there is a natural reason for not overloading the stomach—the cause of many, and often serious, complaints. The natural way is to give the food in small quantities at short intervals, thus, again, imitating the natural way in which a calf feeds when it suckles its mother. The method, almost universally adopted, of dividing what is considered the daily allowance into two or three portions, and giving these at three times during the day, is the very worst that could be adopted, if the lessons which nature gives are to be followed. The animal is certain to suffer from this method, and this from a number of causes. Amongst others may be named the excitement caused by an unnatural craving for its food, and, as feeders know, all excitement or restlessness is hurtful. In point of fact, if the calf is to be brought up in the best way, no small amount of observation is demanded from the attendant; that observation, duly exercised, will give many hints which will be of vast service to him in keeping the calf in the steady, regular, onward progress which admits of no backening, and which is the great point to be aimed at. Whilst large quantities, on the one hand, are to be avoided, on the other the calf must not be hurried in the taking of its allotted portion. Naturally it pauses from time to time, and these pauses should be rather encouraged than otherwise; it is a great mistake, which some feeders make, to get the calf to take its food as quickly as possible. We cannot too often or too strongly impress the fact upon the feeder that great patience, kindliness, and observation of what are the circumstances of natural feeding must be given.

We now take up the details of hand-feeding. And first as to the quantity to be given to the animal. It is obvious that at first this will be less in quantity at the earlier than at the later stages of the calf's progress, which points, therefore, to a gradual increase in quantity, proportionate, as far as can be conjectured, to the development of the calf. A general allowance is from three to four quarts a day; this, however, is milk of the best quality, not poor skimmed milk. Other feeders give a much larger quantity, in fact this at one meal, and three meals a day, in place of making it the whole day's allowance. This, however, we conceive to be too much, at all events when the calf is very young; but

the truth is, no fixed rule can be given, and, indeed, should never be aimed at. The observation we have alluded to must be exercised in order to ascertain as nearly as possible the real wants of the animal, never forgetting the caution as to overloading the stomach. The milk should be given at a temperature as nearly approaching that of the natural milk of the mother as can be guessed at; the animal will be none the worse if this is increased during the cold frosty weather of winter.

That milk is the natural food of the calf is clear enough when we consider its constituents, all these being absolutely necessary to maintain the calf, and build up, so to say, its whole system. The butyraceous and saccharine constituents giving the heat and fat producing properties, while the mineral constituents, as lime, magnesia, iron, &c., form the bones, the caseine or cheesy constituents forming the flesh—these are not only all present in milk, but they are present in the exact proportions required to meet the wants of the calf. It is obvious, however, that in many cases, especially where a large number of calves are being reared, the necessary supply of milk, whether of sweet or skimmed, cannot always be obtained, so that feeders are forced, as it were, to form substitutes of their own, either to supplement the deficient supply of milk or wholly to take its place. Some feeders, however, prefer these substitutes as being absolutely better food for the calf than milk; while others do so from motives of economy, using the substitutes and selling the milk. Reverting to what we have said as to the constituents of milk, both are in the wrong. Nevertheless, it is only right to state that remarkably good substitutes are in use, which bring the calves forward with striking success. From the diversity of opinions upon other departments of farming these substitutes are exceedingly varied in character, and it must be obvious that while some approach, with singular accuracy, the standard of natural milk, others are just as far from attaining it; and that, at the best, it is a very difficult problem to solve.

The obtaining of an artificial food, possessing not only the constituents of milk, but also the exact proportion in which they are present in it—the latter being a physiological point, but seldom thought of by feeders—is one of great practical importance. There are certain points in making artificial

foods for a calf which must be attended to as essential: first, their action upon the bowels, and the general influence on the health of the animal; secondly, that when changes in the character or constituents of the food are made, these changed foods must not be given, so to say, abruptly to the animal, but must be given gradually. We may here observe that, in later stages at least of the animal's progress, all changes in food are beneficial to it, it being a great mistake to keep an animal perpetually on the same kind. To give what we may call a health-sustaining food, a portion of it should be made of good milk, another constituent being some of the fat vegetable matters, such as linseed, this last acting beneficially on the bowels. As before stated, artificial substitutes for milk are exceedingly numerous; but the following stands high in the estimation of practical men, and has been found very successful. Four quarts of linseed meal and four of pea or bean meal are mixed well together, and then made into a thickish fluid by the addition of thirty quarts of boiling water, the whole being allowed to stand for some twelve or twenty-four hours. To the portion hereafter to be named to be taken for a single meal for the calf, a quantity of skimmed milk, in proportion from one-third to two-thirds, is to be added, at such a temperature as, when mixed, it will be that of the mother's milk. The following is the method adopted in using this. During the first week the calf is fed upon milk obtained, if possible, direct from the cow, and, if not, good sweet milk must be used, the daily allowance being four quarts, given at four intervals; in the second week the mixture above named is begun to be given at the rate of five quarts a day, this quantity being increased each succeeding week a quart a day until the third month is completed. After this the calf is put upon other food, the kinds of and methods of giving of which will be hereafter described. In the making up of this artificial food special attention should be given to its effects upon the bowels of the calf if bean in place of pea meal has been used, beans having a constipating tendency, although admirably adapted for the formation of flesh, firm and sound in character. To reduce this tendency is one of the objects in putting linseed meal into the mixture; and other objects, also important, are served by it—too much attention cannot be paid to the state of the animal. Treacle is used, with very good effect, in the formation of artificial food, along with skimmed milk and

finely powdered oilcake of the best quality, the proportions being, to a pint of skimmed milk, half an ounce of treacle and an ounce of the powdered oilcake, a gallon of milk being added to the whole; the quantity of this being used as in the last receipt, the quantity of oilcake towards the end of the six weeks being slightly increased daily up to the end of the twelfth. As already stated, receipts for artificial food are so numerous, we could go on for many pages adding to the above, but the general principles having been stated, these we deem sufficient for the purposes of our paper. We may state, however, that a very excellent fluid in the formation of artificial food is an infusion of finely chopped, or cut, hay of the best quality, made by pouring boiling water over the hay, stirring up the mixture, and allowing it to stand two or three hours. This hay-tea is given along with oilcake, treacle, &c., &c., skimmed milk always forming a part of the mixture. Hay-tea being in proportion of one-third of the skimmed milk, meal, other than bean or pea, may be used, such as barley, oats, Indian corn, locust bean, carrot, or wheat. Of these, perhaps, barley is the best, at least at the earliest period of feeding, wheat meal having too constipating an effect, which however may be reduced, as already stated, in the case of bean meal. In naming the proportion of hay-tea and skimmed milk, it is obvious that this is purely conventional, inasmuch as no specific strength of hay-tea has been named or can be precisely obtained; the proper strength must be found out by observation, and applied accordingly. The same remark applies to all other materials, the observation of their effects upon the animal being the only true guide. Before dismissing the subject of feeding by milk substitutes, we must draw the especial attention of the reader to the great necessity there is for the dairymaid or cowman to attend with scrupulous care to the cleanliness of the vessels in which the food is given. This is of the utmost importance, for not only does the old food, or other substances, as dust, &c., which are too frequently allowed to collect and remain in the vessels for weeks at a time, materially affect the value or quality of the food which the calf is partaking of, but they exercise a hurtful effect on its health, and frequently induce on its part a loathing, or dislike to its food. Care also must be taken to have its crib kept clean, while the litter on which it lies must be of the sweetest and

freshest straw, cut into short lengths, this being most comfortable for the animal, whilst it is most economical for the feeder; and as the calf is generally troubled with skin parasites, these, as for example lice, will, if allowed to remain undisturbed, increase to such a degree that the poor animal will be restless night and day—a condition in which it is impossible for it to make any real progress. All these, and other points which must be obvious to the reader, must be attended to with unfailing regularity.

We now come to that period in the life of the calf when liquid, or milk substitutes, give place to solid food. This is a very trying period for the feeder, testing generally his kindly patience to the utmost, for very difficult is it at times to get it to eat the foods which are given to it. This is on the supposition that it is hand-fed; if nursed by the mother up to weaning time it will likely have more easily learned to take solid food by being along with its mother, although, oddly enough, in many cases the calf shows a tendency to take solid food before it ought, or is capable of digesting; this shows itself generally by its nibbling away at its straw bedding, or rather at the straw of its bedding. This habit, if persisted in, does the animal harm, and must be put a stop to; if not by coaxing and persuasion, by putting on for a period a leather muzzle. In cases where the calf shows a decided dislike to solid food at the period when it must be fed upon it, this dislike will be best and most speedily overcome, not by harshness and attempted forcing, or any attempt at forcing, as tried by too many, or by leaving the animal to be starved into it, and to take care of itself as best it may, but by kind, gentle coaxing, giving it by hand, if in the summer time, a little of the good sweet grass, vetches, or rape, or if in the winter, good hay, small pieces of turnip, and oilcakes; and in all cases where green food is given, it should be at least sun-dried, not dew-wet. When once the habit of eating solid food is established, great care is requisite not to allow it to eat too much of grass, turnips, or mangold-wurtzel, as this is almost certain to give it the scour, or skit, as it is vulgarly termed, and in this way mangold is the worst, especially if newly taken up; and in the cribs or feeding-trough in the yard a lump of rock-salt should be firmly fixed, so that the animals can lick at it at will. Not only are they exceedingly fond of salt, but it

exercises so beneficial an influence on their system, that it ought to form part of their regular food. When first put out to grass, they should be put out for a short period, and not exposed too long to a change which is very great and sudden for them. Should they at any time happen to get wet when out, when brought to the house they should be gently rubbed till dry, as they are very liable to take cold. At first it is the best plan to pasture them in a small paddock by themselves, and grass should not form their whole food; but when housed at nights they should have given to them a moderate feed of cut green food, along with a small portion of oilcake and a handful of good sweet hay. In thoroughly wet weather they should be wholly housed. Many a valuable calf has been lost, or greatly injured, by long exposure to rain, damp, or cold winds. This may be taken as a very brief description of the summer management of calves, and of the best method of getting them accustomed to take solid food. The winter management is, of course, different; they should be wholly housed, having only, during fine weather, a daily run in the yards or paddock. Great attention must be paid to the kind and quality of their food, all changes being gradually made, and attention paid to the caution already given as to the eating of turnips or mangold-wurtzel. If a variety of roots are cultivated on the farm, carrots, parsnips, beet-root, Jerusalem artichokes, or kohl-rabi, these are made to form part of their food during the winter season. The hay given them must be the new season's hay, and of the best quality; a very good food can be made of cut straw, the oat being the best, having mixed with it a little pounded oilcake and some home-ground meal, barley, beans, or peas. The general attention to their health, state of the bowels, cleanliness of body, of their cribs, or house, &c., and to which allusion has been made in this and other sections in this volume, is imperatively necessary; greater attention, if that be possible, being paid during winter, when they are so much confined, as to their cleanliness and all connected with them than during summer, when they are so much out in the open air. By far the best way of housing them is to give each calf a crib to itself, about five to six feet square, provided with small trough, manger, and hay-rack, the calves being only allowed to herd together when turned into the yard common to all the cribs. As spring approaches they should be turned out

to pasture or paddock gradually, and for a short period only of the day, the change from winter food to grass being done with great caution. Such may be taken as an equally brief statement of the winter management of young calves; their treatment as young stock will be found in the appropriate paper.—"The General Care and Management of Dairy Cows," p. 112.

CHAPTER VI.

GENERAL FEEDING AND PASTURAGE OF THE COWS—TRANSPORT AND TREATMENT OF THE MILK—TRANSPORTATION OF MILK—COOLING OF MILK.

When a herd of cows has been selected, with a male of the suitable breed and quality, the shed receives its lodgers into travises of two occupants that are tied by a neck-chain to a post of timber placed one in each corner of the room or lair. Some of the animals that are dry in milk, lame in foot, partially diseased, or in any way unfitted for the common treatment of the house, are lodged in yards, shown in the general plan of the buildings, which are provided with covered sheds, cribs for dry provender, troughs for water, and a comfortable bed of short straws for litter. Commencing the year in October, as at that time the food of summer is finished and that of winter is introduced, the staple article of food is the dried herbage of the permanent grass lands, well known as meadow hay, which is found to be most agreeable nutriment both to cattle and horses, producing health and flesh in a high quality, with milk in the same degree. The hay in sheaves cut from the rick by hand-knife, or in chaff from the cutting-knives, is placed in the cribs and racks at stated times daily in a quantity to allow an ample sufficiency without any waste or leaving a refuse to be withered into uselessness, and breathed and

blown by the animals into an utter disrelish. The meal of juicy food in steamed roots and chaffs may be given the last at night, in order that the mastication and the mixing with the other food may have the benefit of the repose of the night. If the produce of root crops does not afford one meal daily to all the cows in the shed, then one meal twice or three times a week may be used, and if that allowance be too large over the quantity of roots that are grown, then one meal weekly must be given, for the benefit of a juicy mixture of some amount along with the dry provender of hay.

The summer provision of food will commence with the foremost crop of tares in April or May, when a daily allowance will be given and continued till the first crop of spring vetches, clovers, and meadow grasses enables the whole supply of food to consist in greenmeat into October, when the winter provision commences. During the summer period the dry food of hay must still be given, in order to correct the laxative tendency of a wholly greenmeat nutriment, which would derange and very much injure the regular flow of milk. Much care and well-considered attention must be exercised on this point, or the milk may be very much injured in the quality and in the regular quantity that is produced.

Depôts should be fixed at the most convenient places in the nearest dense suburbs of the city or town, to which the milk will be conveyed and delivered to the retail vendors. A railway of a simple gauge will lead from the depôts to the farm and into the cowshed, running on wheels shod with gutta-percha or some similar substance of a softness to prevent the agitation and jumbling of the milk. Light iron trucks are placed on four wheels, with a central longitudinal iron bar or bars

provided with hooks, on which are suspended the tin cans that contain the milk, with graduated marks to show the quantities. At the depôts the railway-trucks are placed on the lowest possible platform, with wheels set at a gauge in width to run on the tramways that will soon convey the load into or deposit it at the end of any street of note for distribution to the vendors, whence manual shoulder carriage will be short to the doors of the consumers, who will return the tin vessels to the farm for daily use. It may be arranged that not over thirty minutes be spent from the milk being drawn from the cow and in the use of it at the breakfast-room from seven to eight in the morning, when the milking commences, and from eight to nine for the various purposes of application. When cream is desired the milk may be placed in a basin and left to repose, when a good coat will be formed by next morning, if cream be preferred. This mode of transit and of delivery prevents any means or opportunity of adulteration, and preserves the quality of the milk from the damage of jumbling by the frequency of handlings. The trucks stand on the central railway of the cowshed, with tin vessels hung on the longitudinal bar along the centre by hooks in the sides, and immediately the milk is drawn from the cows it is passed through a sieve of very fine hair-weaving into the vessels, which being filled are immediately drawn to the depôts by a very reduced power of steam at a gentle speed. This performance is quickly done by a large force of hands in milking the cows, and by the general arrangement all the tricks of trade are prevented, and the article is delivered in its primitive quality and genuine purity.

When more than one shed is required on large farms the position of the edifices will be as nearly adjoining as

possible, with a parallel frontage from which the line of carriages that convey the milk in cans may be pushed along the railway by hand to join at a sharp angle of divergence the central line that leads to the chief depôt, which will have at least one diverging line on the right and left to permit the access to the depôt, provided for the special purpose. In this way one central line may accommodate at least one farm on the right and left of a chief establishment that fronts the depôt.

The yearly produce from the farm in the calves from the milch cows that are kept will come into consideration, and which should be treated or reared so as to be profitable. The farthest distant suburban farms will be engaged in rearing calves for veal, and could receive calves from the milk farms with a mutual convenience, obtaining in return a certain supply of essential articles, disengaging the latter from an incumbrance, and with the certainty of a valuable return; or a number of cows on the milk farms may be employed in rearing into veal the annual crop of calves, where the milk might thus be as profitably used as by the article sold as produced. This arrangement may somewhat vary the employment of the undertaking, and appear to change the object of the institution, but some little change may render the office more agreeable, and also vary the direction of the labour required. Either way will suit the purpose, as the object is single and uniform.

The portion of arable land that is employed on milk farms in proportion to the quantity of permanent grass must depend on the nature of the soil on the whole farm, if it be suitable for growing root crops, or stubborn and heavy beyond its easy adaptation for the purpose of producing greenmeat plants. If roots and esculent plants can be grown with the ordinary means of cultivation,

and if the returns are fairly abundant, as much as one-half of the farm will be beneficially used for the production of roots and greenmeats to be consumed along with dried provender, and some grains for general purposes, with straws for litter. Some situations of very suitable soils may justify a large amount of arable grounds, and with a greater extent of permanent grass, thus constituting a more extensive farm. A greater extent of arable lands may seem to change the purpose of milk farms and also to distract the attention from the main object; but the chief purpose is still maintained when several means are used to promote it. The proper quantity of these means, the kinds and suitable adaptation to the soil and climate, and to the probable remuneration, must depend on the judgment of the practitioner and the general circumstances that attend all undertakings. Sound judgment is required to weigh all the circumstances that are inherent and fixed, and to make a due allowance for the adventitious and contingent.

The ready and adequate supply of milk in its natural condition for the use of cities and large towns has not escaped observation and inquiry, along with similar provisions for the comfortable maintenance of the human race in large social assemblages. The easy readiness with which any articles purchased to supply a constantly recurring and never-ceasing demand forms the primary consideration, as the use of milk admits of no delay and must be instantly served. The daily and hourly demand necessitates the prompt delivery of the article, as time cannot be spent on the errands of fetching, and the culinary preparations are peremptory in the necessaries for use and preparation. The entire preparation of useful articles of any kind, done at the

cost of labour and expenditure attached, is wholly lost and sunk from the want of readiness at the proper time and place by a neglect even in one point of preparation, which has the power of rendering all other adjustments, however correct and nicely arranged, to be of no avail and worse than useless, and only remain to show the want of a solid foundation in the whole system of action, and a most miserable absence of the calculation that is required to form a continuous chain of economic employments. The readiness with which an article may be had at the appointed time very much enhances its value; but in most cases the value is wholly lost at the fixed time, as it cannot again be recovered for the special purpose. In the case of milk, which is a very perishable article, the value decreases as time advances, and the first condition of good quality is not recovered as in the case of other articles, where, though the present occasion fails, the article remains perfect in the primary state for future use. The circumstance of milk being damaged by exposure, and from the time that elapses between the issue of it and its use, very much increases the necessity for a quick arrangement for its conveyance to the places of use, and in placing the article in the possession of the purchaser. If this provision be delayed or negligently performed, all other provisions are useless and fall to the ground. It is not an article that is forwarded to perform a certain function, and by being absent the object is not attained, but it remains for a new application and another performance; but milk is a perishable article, and if sent for an immediate use and consumption, and not being present when required, it is damaged by the neglect and sinks in value. Hence arises the last necessity of its readiness for use, as every moment of time depre-

ciates the article not only for the immediate application but for any future use.

A scarcity of any article merely shows the imperative necessity of filling the deficiency, produces discontent from advancing the price of the article, and shows that the provision can be made if the means be allowed and used. An over-abundance of milk never can exist, nor the price be ruinously low, even if not fixed, as the article can be turned into veal and cheese, and not under the market price. The want of quality in any articles sinks the value that is derived from the business, as the same preparation will in very many cases do the work necessary for a large quantity with no extra cost over a small, and the same care and attention will suffice for a ton as for a hundredweight of bulk. A certain quantity of any articles, or the extent of any trade or business, is required to justify the cost of machinery, which is usefully employed in its power for producing a result of a pound when a ton may be obtained by the same application. The same railway that conveys to market the milk of twenty cows will carry that of ten more, and due attention in transacting the business can easily manage the addition. Hence the necessity of a careful adaptation in every branch of business that every part be fitted to the other, in order to produce the required results in unison and in harmony.

An article being provided in the adequate quantity to supply the demand, and having been brought into the necessary conditions of readiness of time and place, in order to be applied to the various purposes to which the nature of the article is adapted, a very high and most important consideration arises respecting the quality and condition of the article when exposed for sale.

Milk being a fluid of very mixed ingredients, has a strong affinity for water, which is a chief constituent of the mixture, and it is consequently liable to an easy adulteration with an additional quantity of water without being detected, as in the case of material bodies the adulterations of which are discernible from the difficulty of a minute and intimate mixture of the grosser elements. The tricks of trade have not failed to take advantage of this facility in mixing milk and water, which cannot be detected without a very exact chemical analysis. Organic life and the products of it are much affected in the quantity and quality by the climate by which they are surrounded, and in which the vital respirations are chiefly supported by the quantity of the articles of food that is consumed and by the natural organic constitution of the animated body from which the fluid is secreted. All inquiries that have been made on the subject of milk in the quantity and quality have ever been unanimous on one point—that the place of production should be airy and unconfined, and wholly removed from the crowded confinement of houses in streets and lanes in which the air is contaminated and unwholesome, affecting not only the act of breathing, but the solid food that is consumed and the water which is drunk. This removal, not yet however much performed, has banished one strong ground of complaint, which was most justly formed and perseveringly retained. The qualitative nature of the articles that are consumed as food, if it be dry and wiry, but still succulent and tending to produce flesh and milk in the due proportion, or rather watery and too juicy, with a habit and inclination to yield a fluid that is thin and washy, exerts a most powerful influence on the milk that results from the consumption. The fluid will be deficient in

cream and in the nutritious juices or gaseous evaporations that constitute the essence of its value. Too large a quantity of one article over others will derange the necessary mixture, and also the qualities that are given at different times. These certainties can only be obtained by observation and experience, as no reliance can be placed on the indications of so many and such very varied influences that rule over the actions of organic life. The best kinds of food have already been mentioned, in the dried provender of the wiry grasses of the permanent meadow, in the hay of clover with one or two of the wiry grasses in mixture, as the ray-grass and fescue, used dry or steamed in chaffs; and in summer the clovers and vetches and other green plants, with a mixture of dry provender and roots. All washy excesses of water in any condition of these must be avoided.

The adulteration of milk being very extensive and undeniable, has met with a universal reprobation, as a most disgraceful loss to society from the very many and varied purposes to which the fluid is applied, both in the natural condition and in the changes which it is capable of embracing. Hardly any other body of so large a production exceeds or even equals milk in the latter proportion of use. But with the exposure and reprobation of the adulterated condition, the letters, lectures, and essays on the subject have always been closed with the fault being detected and exposed; but no remedy nor no better mode having been devised or proposed, labour is wholly misspent without result, and without any benefit being proposed. When an old house is condemned and pulled down, a new and a better edifice should, or is, and must be substituted. Such is the fate of the most vital subjects, and of matters that affect the community at large,

mostly always disregarded and postponed, while individual interests and comparative trifles are pushed into activity and settled in their benefits. Detection of fraud is in every way most commendable, and the exposure of it leads to very large social benefits, but the prevention is much more simple and far less troublesome. The scheme now delineated will remove wholly and entirely the adulteration of milk by the simple rapidity of its transition from the cowshed to the depôt, and thence to the consumer, affording no time or opportunity for carrying out adulteration, and with the aid of a vigilant surveillance to watch and detect any attempts that may be made for that purpose. The milk being placed in a tin vessel in the cowshed, conveyed to the depôt, and carried to the consumer, and measured from the same vessel, the handlings and the plungings are prevented, which damage the fluid probably as much as the mixture with water. It is conceived that the present arrangement, by the inspection at the cowshed, the quick movement to the depôt, with a careful surveillance at that position and the same vigilance at the door of the consumer, will effectually prevent any opportunity of mixing, and remove a long-standing grievance that only wants the simple application of some little sense and energy, as is the case with many similar arrangements. In the present mode of management the milk is plunged into tin cans, carried to a railway station, thence on jostling seats, plunged again into cold vessels, carried swinging along the streets, and measured in small quantities to the consumer, after many hours of handling and plunging, until the colour is wholly lost, and any vestiges of the original condition are nearly wholly banished and expelled. Never has a more cruel treatment been inflicted on any article of common mer-

chandise, and never has the remedy been so shamefully neglected and delayed in any matter of an equal or of a superior consideration.

Recent Improvements in Milk-cooling, and in the Transportation of Milk from the Farms to Towns or Factories.

A very important department of the dairy department is the cooling of the milk as early after the milking as possible. It is only very recently that the importance of this, or rather the necessity of having it done, especially where the milk has to be removed or transported to a distance, as by railway or cartage, from the place where the cows are milked, has been recognised. At one time it was supposed that the cause of milk going bad on being moved from place to place arose from the motion, subjecting the milk to a species of "churning," so to say. But it was observed that even in cases where the milk was kept in a quiescent state, and subjected to no more motion than is usually given to it in removing it from the cow-house to the dairy or milk-house, it kept better and for a longer period when, by one means or another, it had been kept cool or rather specially cooled or lowered in temperature immediately or soon after being milked. Various theories have been brought forward to account for this, but the following is that now, perhaps, most generally admitted to be correct, and as stated by an eminent authority.

The active principle of fermentation in milk may be said to be lactic acid, and any means by which the formation of this can be prevented in it will naturally tend to reduce the tendency of the milk to change its character; and the chief advantage of the cooling is to prevent the formation of this acid, heat greatly tending to this, as all dairymaids know. Another advantage derived from cooling the milk is that if there are present in it, as too often there are, the germs of putrefaction, their activity, or tendency to proceed to higher forms tending still further to reduce the quality of the milk, is greatly lessened. This alone would render milk-cooling an object of great importance in dairying, for a much larger quantity of milk is destroyed every year from the presence in it of these putrefying germs than is generally thought of.

The Fixed or Permanent Apparatus or Appliances in the Dairy for cooling Milk. The Water-tank and Vessels.

The methods introduced into practice for the cooling of milk have been exceedingly numerous, from forms of apparatus or contrivances which have been made part of the fixed furniture, so to call it, of the dairy, to those portable ones, the arrangements and construction of which may be said to be endless.

Of what may be termed the fixed or permanent forms of coolers, the best known are the water-tanks. In those tanks the milk is put into tin cans or pails, and the water admitted at one part flows amongst and around the cans, and, abstracting the heat from the milk, passes out at another part of the tanks. On the first introduction of the tank system, which we owe, like the majority of our improved dairy contrivances and arrangements, to the inventive genius of the Americans, the plan first used was to place the milk to be cooled in very large cans or pails, no doubt with the idea that more work would be done in less time. But this, as might be conceived, did not succeed; and the method found to be perfectly successful, and now universally used, is to have the milk placed in comparatively small-sized tins or pails, the dimensions calculated to give the best results being seventeen to twenty inches in length and eight inches in diameter, provided with a swing semicircular handle at upper end for convenience of lifting in and out of the tank, and carrying the can to and from it.

The tanks are situated within the milk-house, there being generally more than one; and each tank is so arranged with reference to the level of the milk-house that the water is just about the level of the floor of the latter. Each tank is provided at the bottom with a wooden rack or open framing, upon which the milk-cans are placed, and these are filled up to within four or five inches of the top; and care must be taken to have the height of the water in the tank and of the milk in the cans or pails at exactly the same level. The best temperature for the water is found to be 56°. When the milk is to be used for butter-making, the period to which it should be allowed to remain in the tank is found to be best at one day, *i.e.* twenty-four hours. When the milk is to be sent to

towns or a distance from the dairy, and has simply to be cooled, it is kept stirred all the time it is in the tanks, in order to prevent the cream from rising. This for a day—the time just named—would be a tedious process; but for simple cooling for transport the time the milk-cans are in the tank is little more than an hour, this being found about the time required to abstract the animal heat, which should be done as fast as possible, and which the stirring also much facilitates.

Packing or securing the Cooled Milk in Cans, Tins, or specially constructed Vessels, for Transportation to Towns, &c., at a distance from the Farm.

When the milk is cooled it is next to be conveyed to its destination, and this to be done properly involves the principle of keeping the milk as far as possible at the same temperature, and not to have it subjected to shaking. In the ordinary system the milk, after being cooled in the tanks, is placed in larger cans, capable of containing some forty or fifty gallons, and the lid or cover is so made and secured that there is no free space between the surface of the milk and the lower part of the cover, the milk being thus, as it were, a solid mass, and thus rendered incapable of motion, so that no shaking occurs. In some forms of carrying-cans there are ingenious arrangements by which the milk is kept cool during transit, cold water or ice being used as the cooling medium. This is placed in relation to the milk-can in a variety of methods, these being very numerous according to the fancy of the designers; but all have the object in view of surrounding the cooler with milk, or the reverse position, the milk with the cooler. A review of the various contrivances introduced would be interesting and suggestive, and show to what a length the inventive efforts of our American dairymen chiefly have gone with the view to improve the practical working of dairies in all their departments, but this space prevents us from giving.

Use of Iced Water for cooling Milk.

In some of the best-conducted of the Swedish butter factories iced water is used in place of cool well water with great effect and economy. The form of the pails or cans has

also been altered, as well as the dimensions, which were about similar to those of the American factories already described. The size of the Swedish can is twenty inches in height, and nine inches in diameter. The cans are for butter-making, and a great improvement in their cooling capacities has been found to arise from taking out the old bottoms, and pressing the sides of the cans together till they assume an elliptical shape, then putting in a fresh bottom. The ice method of cooling the milk is adopted in all the Swedish factories, the practice being to break the ice into small pieces, which rapidly reduces the temperature to as low as from 39·2° to 35·6° Fah. One great advantage obtainable by the use of the ice method is this, that while the cold-water tanks have to be so arranged as already described that the water has to be perpetually changed, by the use of ice the water does not require changing more than a few times in the year, the surplus water caused by the melting of the ice—a very small quantity—being carried off by a very small overflow pipe.

Ice-houses for Dairy Farms.

Now that milk-cooling and the preservation of butter and other produce of the farm by cooling processes is carried out to so large an extent in some countries and is rapidly spreading in this, and as ice is a substance found to possess very numerous advantages for this department of farmwork, it is obvious that the construction of an ice-house should form part of the farm buildings. At one period the construction of such buildings or stores was quite an elaborate affair, involving much both in the way of arrangement and construction. The matter is now much more simple than it used to be. Perhaps the simplest method is that adopted in Sweden, and it is one which is carried out in connection with butter factories, already and just alluded to, and which has proved eminently successful. The following is a brief description of it. The ice is heaped up in pyramidal forms, either in an open shed, but by preference in the open air, the foundation on which the ice rests being formed by a thick layer of some good non-conducting material, as peat, sawdust, tan bark, &c.; this is at least one foot thick. As the ice is packed the spaces left between the different blocks

which form the heap are carefully filled up with sawdust to prevent radiation; and when the pile is completed, the whole surface is thickly covered up with the non-conducting materials above named. When ice is taken from the pile when required, it is always taken from the top of it, and the part which has been exposed carefully covered up with the material as before. The annual loss from a pile of this sort is found not to exceed one-fourth of the mass, and the bulk required to cool the milk is equal to the bulk of the milk to be cooled, or thereabouts.

CHAPTER VII.

CAPITAL, ETC., REQUIRED IN MILK FARMS—MANAGEMENT OF THE MILK DAIRY—IMPORTANCE OF CLEANLINESS —VESSELS EMPLOYED—GENERAL MANAGEMENT OF THE DAIRY COWS.

THE foundation and structure of suburban milk farms must rest on ample means to rear the edifice, and to place the necessary machinery of action, and to support the undertaking till the returns of the traffic are able to defray all expenses, and to yield an item of profit, or a percentage on the cost of the expenditure. The amount of means required must be ample and ready for every occasion, for a niggardly use of the provision to forward the undertaking imposes delay, destroys the movements, baffles the arrangements, and renders vain the efforts of all the performances. True economy consists not in getting things cheaply done, but in getting them well done, for imperfect performances are worse than none, as encouraging the process of the undertaking to produce more imperfections, while the business is lost in stagnation, dwindling into loss, and ultimately into a total ruin. In addition to the ample means of structure which are allowed by the best modes of calculation, there must be a reserve fund for the purpose of supplying wants and meeting accidents, in order that no stoppage happens from want of the wheels of machinery being continuously fitted for action. The amount of

the fund should not be under one-fourth part of the whole sum to be embarked in the undertaking, and may be larger but not less, as a want in its power will be a more serious evil than the deficit of the original amount of means allowed to construct the edifice. More rather than less in every calculation is the safe ground of business, but not in any outrageous manner on either side to betray an erring ignorance of the business. Moderation must run as a silken string through every calculation and arrangement of human affairs. The educated uuderstandings that have been reared from an enlightened practice of agriculture, assisted by a varied education, which is as a heap of embers to make a glowing fire, must be employed to draw the plans and make the estimates, for no person can pretend to assist in any business without a long, a varied, and a most comprehensive acquaintance with the practice of the details. No other person can pretend to it.

A manager must be appointed for the purpose of directing the general object of the undertaking, and to obtain the end in view. He must superintend the necessary improvement of the lands in draining, fencing, and the digging alterations by extraneous substances. The erection of the buildings will require a careful attention, which, along with the railways, will form a very chief object of employment. The preliminary objects are the foundation of the undertaking, and upon the faithful performance of these preparations the success of the business will very materially depend. This superintendence will extend over all matters of expenditure, and so to satisfy the farmer that the money is properly applied to the special points of use. All furniture or appliances must be effectually supplied, as they form, so to say, the legs on which the live stock

or the acting power of the farm must run. The base must be wide and level to permit an easy course of passage for the active performances that must be transacted. If the road be not plain and easy, breakages and losses must ensue.

Cleanliness in the Dairy essential. Utensils, Varieties and cleansing of, &c. Churns.

One great element of success—some dairymaids say it is the one element—in dairy-keeping is perfect cleanliness in the utensils used, and indeed in every part of the dairy. First as to the *utensils*. It is obvious on consideration, although the consideration is not always given, that different materials will possess different capabilities or capacities for being kept clean. We confess to being anxious to retract the word obvious, for in point of fact this is so far from being the case, that the practical knowledge we have, so far as it is derived from experimental investigations and patient inquiry, affords us little guidance as to the best materials to be employed in the construction of dairy utensils. We treat the subject in a general way, and talk of this material being better than another, but if asked to state why we believe the one to be better than the other, we fear the majority of us would be able to put "upon the record" very few facts of any worth bearing decisively and conclusively upon the various points.

Wood Vessels.—Thus probably the majority of dairymaids have a preference for wooden dairy materials, and certainly when kept as they ought to be kept, in the highest state of cleanly purity, nothing is more pleasant to look upon, and no other material seems to convey in its appearance as it does the idea of cleanliness. But after all "looks" do not alone decide points such as this, and we find on closer investigation that it is far from doing so in the case of the material now being considered. We have already drawn pointed attention to the fact that there is scarcely any material which sooner acquires a bad taint—and keeps it longer when it gets it—than milk. Hence if in the dairy there be any place in which milk can lodge, and from which it may be difficult, and in some cases almost impossible, to dislodge

it, some idea may be formed of the result. Now vessels made of wood for keeping up the milk or cream, however perfectly made—the term here is of course used in the workman's sense—have imperfections which give rise to "chink and crannies" in the joints, in which the milk lodges, and from which, in too many cases, even with the most scrupulous cleanliness, it cannot be dislodged. Judge, then, of the state of matters where this state of scrupulous cleanliness is not the characteristic of the dairy. But it is somewhat of a discouraging fact to find in the case of wooden utensils that there is, so to say, but little encouragement to exercise this scrupulous cleanliness, for if exercised in a certain way the "cure becomes worse than the disease."

Defects of Wood Vessels.—This curious and by no means pleasant discovery, if discovery it be, we owe to an American agricultural paper. The American papers are the source, it should here be stated, of by far the most instructive and practical facts connected with dairying which are published in the English language; we use the term here to indicate that we are not forgetful of how much we are indebted to German and French papers for information of the same class, perhaps more scientific in its general aspects than popularly practical. We say we owe this discovery of a fact or circumstance connected with wooden dairy vessels to an American journal, the author of a paper in which, on the general subject of cleanliness in such appliances, points out, what of course has long been known to all who have had anything to do practically with timber, namely, that it shrinks with drought and swells with moisture. This "giving and taking," to use a technical mechanical phrase, is continually going on, although of course it is at times more noticeable in its effects than at others; but that even at times when apparently no such effects are observable they exist, and cause such shrinkage as to make "lodging-places" for milk sufficiently large to be sources of considerable evil. Now this "giving and taking" of the joints of vessels is greatly increased by the very habit of cleaning the vessels in water, and this evil is increased by the practice of drying them, or perhaps rather non-drying, in the sun or in warm air. Now vessels so treated, and supposed, in the language of the dairy, to be "perfectly clean, pure, and sweet," when milk is put into them, some of it is sure to

lodge in the chinks, and when once there the evil is not got rid of by washing out the milk. If the greasy portion could be washed out also, the evil would then indeed be eradicated; but what is the action of grease? Wherever it is present it tends to soak or sink deeper into the substance with which it is in contact, and we all know how liable wood is to absorb grease, and what is worse, so far as wooden dairy utensils are concerned, to retain it, the grease sinking into the fibres of the wood and filling them up, so that it is almost impossible physically to remove it. Physically we may say impossible, although chemically it can be done; but then if so done, it is done at the risk of spoiling the fibres of the wood and making the joints worse.

The philosophy of the matter, so far as concerns wooden dairy utensils, is thus explained in the article above referred to. Wood vessels, thoroughly cleaned with pure clean water, probably absorb but little more milk during say the first half-hour after the milk is put in; but if the utensil has previously been well dried—on which point a word or two will be given presently—the milk is absorbed into the pores, and the wood then getting wet it "swells," and the milk is thus "locked up," so to say, in the pores or chinks and joints. Succeeding washings and dryings of the utensils drives the water of the milk out, but there is left behind the condensed milk in the form of a fatty greasy curd; and this it is which it is so difficult to expel, and which therefore becomes rancid and putrid, and being greasy sinks into and is absorbed by the wood as above stated, and is there retained.

Best Method of treating and drying Wood Vessels.

Now from this statement of the philosophy of the matter, it would appear that the best method of overcoming the difficulty would be, first, so to treat the utensils that the "giving and taking," or shrinkage and opening, of the pores would be prevented. Now the most obvious method to prevent this is the drying of the utensil in such a way that it will be uniformly done, and done moreover at a moderately low temperature only. Hence, then, at this stage is seen the absurdity so often, shall we say so universally, practised, of having the utensils kept for hours baking in a hot sun or in

an equally hot drying or scalding room, till the whole surface of the wood, to say nothing of its chinks artificially made in the manufacture of the article, is opened up by a net-work of veins and pores; and chinks thus formed naturally become the receptacles for the greasy residues of the milk above described. The remedy is obvious, and it is as easily carried out as it is obvious.

The second remedy for the evil, putrid, greasy filled pores of wood utensils, is this somewhat paradoxical yet common-sense one—to keep the grease out. The natural antagonist of grease is water; if the surface and the pores alike of a wood vessel be filled with pure clean water, the milk and its greasy particles cannot enter them: another philosophical fact also preventing them doing so, as no two bodies can exist in the same space at the same time. If wood utensils, then, be rendered perfectly sweet and clean by the use of pure clean water, and only *surface* dried—if even not that, so that the quantity of water left will not in any appreciable degree weaken the quality of the milk put into the vessels—then the milk may be put into them with the perfect conviction that none of it will enter the chinks or pores. A familiar illustration of the principle here advocated is met with in the wooden butter-worker, or in the spatula of the chemist; if these be kept wet, greasy substances may be worked with ease, and not a particle will adhere to the surface of the wood. But use the wood in a highly dried state, and, what is worse, warmed in addition, then the difficulties of working will be so increased that it will be by no means an easy matter to carry on the process. All these points, and others which will present themselves to those practically concerned in dairy work, prove how important it is that a strict outlook, so to say, be kept on all departments, for even what may be deemed a very simple and important detail may, if not directly influencing, at least indirectly influence the economy of a very important part of the dairy system, and may cause much loss of time and money. It is, perhaps, difficult to name any department in which constant watchfulness and care are more frequently demanded than that of the dairy.

Presence and Propagation of Fungi causes of Taint in Milk, as modifying Plans of treating and cleaning Utensils.

But greatly conducing as cleanliness in everything connected with the dairy is to its success, it will not be using a brief space amiss if we draw attention to one or two points which closely affect the object at which thorough cleanliness aims, namely, the prevention of the tainting of the milk, which, if once done, no matter how, inevitably injures more or less the produce, whether this be butter or cheese, or permanently the quality of the milk itself if that be retained for sale. Of these, perhaps, butter is the most important to be kept free from taint, as at all events it is more noticed in it by the palate, or if noticed in cheese, may be, and generally is, set down to the "goût" or peculiar flavour which may have been designed to be given to it.

It must be confessed that the view which recent expositions of science have shown to be correct is rather a depressing one, namely, that in spite of all the scrupulous attention to cleanliness which alone, in combination with the keeping away of the milk from known and appreciable sources of bad smells and foul odours, was deemed necessary, the dairy produce is liable still to be tainted. Nevertheless these same researches show that means are at the disposal of the dairyman of overcoming, or at least greatly modifying, these causes of tainting.

What those causes are a few lines will suffice to explain, so that the reader will be able to draw from them some practical deductions. The researches of our eminent savants into what is called the germ theory of disease have shown that the spores of fungi are everywhere present nearly. The air may be said to be thick with them; they abound in living and in dead organisms, and are carried into, or are absorbed by, nearly every class of organic matter. Each peculiar germ or fungi has its own substance, in which it, so to say, is at home or delights in. And certain conditions of substances attract certain fungi. All of them are remarkable for the amazing rapidity with which they will "increase and multiply." One germ, or fungi, produces every forty-eight hours—which is the limit or period of its ephemeral existence—hundreds of spores, which again running their brief

span of life, such as it is, produce hundreds more, and so on goes the line of production till, like Banquo's, it may be said, to "stretch out to the crack of doom"—and a bad doom it is for some things, animate and inanimate. But this is not all: some fungi, while they increase at this prodigious rate, as they carry on their own kind or species, produce other species. Thus, the one we have alluded to produces every few hours two specimens of another species, each of which produces two others every few hours, so that some idea—if indeed any idea can be formed of numbers so enormous—may be had of the rate of increase of those germs. The moment milk is taken from the cow they attack it, become mixed up with it. It is some comfort to know, however, that if the milk be pure when it comes from the cow they do no harm to it. But if those are produced from putrid milk they do great harm. If so produced, and are present in the air of byres or cow-houses, they are inhaled into the lungs of the cows, and permeating, so to say, their system, the milk is rendered impure before it is withdrawn from the udder, so that when withdrawn it is in the most favourable condition to be tainted and rendered unwholesome by the attacks of the germs as already described. Now those putrid germs become present in the air of cow-houses when the air is drawn from sources at which putrid or decaying matter is lying. Get rid of this, the evil is prevented. The germs are conveyed almost with unvariable certainty in stagnant and impure water also: this indeed is a fertile source of evil results, and it is one which by no great outlay of care or money can be avoided. Cows are often allowed to stand in the mud and filth which in ill-regulated farmsteadings accumulates near ponds, gates to fields, courts, &c. It may be new to some to be told that the impure mud—for it is contaminated by droppings and other "vile and villanous objects" becoming attached to the bodies, udders, &c., of the animals—affords admirable "nests"—so to call those mud spots—for the germs to lodge and increase in. This is abundantly proved by investigation. And these germs pass from the animal to the milk-pail. We have not said a tithe of what we could say on this important matter; but we have suggested enough to show that there are reasons other than those we have in previous places stated for having the most scrupulous cleanliness in everything connected with dairy cows, not less in

the condition of the animals themselves than in that of the buildings in which they are housed, the vessels out of which they are fed, and the various appliances used in connection with them. It is often deemed that all is done if one department only be attended to in this essential element of cleanliness and order; but we have given enough to show that it is equally essential in all departments; for "dirt" being a vehicle by which the germs of disease can be conveyed from one point to another, it is necessary to keep all parts of the building, every part of its surroundings, and the animals themselves in the highest state of cleanliness and order, so as to be thoroughly and constantly free from it.

The whole question or subject of the management of the sale and market department of milk farms, or of general farms, by which the milk produced is sent at once to be sold, has entered of late into altogether a new position, and presents some remarkable and striking phases, to the most important of which we have directed the attention of the reader. We have just pointed out certain essentials in what may be called general dairy management, which is the ultimate point to which all the work of milk farming converges, and at which success or non-success in it culminates, those being the general management, arrangements, and cleanliness in all departments. That these have an important influence upon the quality of the milk, we trust we have clearly shown; but this quality, if not absolutely improved, is at least maintained, by a process which has created great interest amongst dairymen—this is the cooling of the milk before sending it out for sale, and which we have described in a preceding note.

General Care and Management of Dairy Cows.

In the space of a note, such as the limits of our work will only admit of, we can do little more than glance at the leading points of a subject of great importance to all concerned with the practical working of a milk farm, to do full justice to which the space of a volume would be required. What we give, therefore, must only be taken as hints, and those, moreover, of the most general kind. These, it is necessary to state, have been arranged to be read along or in connection with the Calendar of the work to be done in

this department, commencing with the first month of the agricultural year, namely October. For obvious reasons, under this plan, notice will now and then, in the course of these notes, be taken of the work done under each month; but these will be of a very general kind, the special notices being found in the Calendar just referred to.

In the general care of dairy cows, few points carry with them so much of practical importance as the *housing and shelter of stock*, especially during the autumn and winter months, and of these October is that which, perhaps, most severely tests the health of stock which are not properly housed or provided with shelter. This arises not so much from the general actual severity of the weather during it, but from the comparative suddenness of the change from weather more or less balmy, mild, and dry, to that possessing the opposite characteristics. So, also, from the sudden changes in the month itself, one day being fine, the other the reverse. These facts point to the necessity of more than usual care being given to the housing and shelter of stock kept for dairy purposes. This, as these terms broadly indicate, is of two kinds, wholly confining the stock to the house, feeding them on the system of "stall feeding," with a short run in the yard during the best period of the day; and, second, partial shelter, afforded by shelter sheds attached to the yard, these being large enough to accommodate a number of animals, or, in the case of "Hammel," only two or three. The two latter methods are applicable only to the young stock which the milk farmer may consider it desirable to keep under the system of breeding and rearing his own dairy stock, which is by far the safest and best, and infinitely superior, as we have elsewhere pointed out, to that of buying in animals from the open market. The cows giving milk are, of course, all "stall fed." Young stock, as a rule, are very carelessly brought up; they are exposed to all the changes of weather; while the dictum of sound sense and the results of successful practice go to prove that the warmth, in a modified degree, and what we call in general terms "comfort," are worth giving to the animals, as they are in every way conducive to economy—truths which are well and graphically exemplified in the saying, "Meat is heat, heat is meat."

From what has been said in the last paragraph, the waste,

to say nothing of the inhumanity, of the system but too frequently adopted of exposing young stock in outlying pasture fields will be at once observable. In the case of young stock, or heifers, more harm is done by the adoption of this system than is generally supposed. It is a rule, to which there is no exception, that if the best paying capabilities of the animals are to be secured, their progress up to the full producing point at which they are ready for the dairyman must be steady, with no backening at any point of their feeding time. To insure this, not only must the food given them be of the best quality, judiciously abundant in quantity, but it must be given regularly, and their general health carefully attended to. Now, however well the feeding be attended to, the latter cannot possibly be secured with certainty if the animals be exposed to all varieties of weather. They must, then, if they are sent to outlying pastures to be "wintered," or "hardened," have shelter sheds provided, into which they can go in wet or cold weather, and these must be amply provided with dry and sweet bedding straw. Do not trust to the grass they can bite as the only food provided for them; care must be taken to supply them with extra food: if turnips be given with straw, the former should be sliced, the latter cut into half-inch lengths, and the whole be well mixed. In all cases add a small portion of salt to the mixture; and, if the weather be exceptionally cold or frosty, the young stock will be none the worse if a portion of good condimental food be added to the mixture. See to the condition of their bowels; inattention to this is a frequent cause of many troublesome complaints, and, if allowed to get into a thoroughly constipated state, leads very often to serious and fatal diseases. A "stitch in time saves nine" is a proverb conveying a sound and useful lesson in this department. To commence the wintering with, it will be advisable to give them a dose of sulphur, ginger, and nitre, which should be repeated occasionally. We have had ample evidence of the value of this in keeping stock of all kinds in general good health. If young stock be wintered at the home-stall or farm-steading—which, if the grazier be wise, he will carry out—it seems to be conceded that the best method of sheltering them is the "Hammel." (The "Hammel" is simply a small shelter shed, about 14 feet by 10 or 12, sufficient to accommodate

two or three young heifers, with an open yard attached provided with feeding mangers, or troughs, and water-troughs.) The bedding in the shelter place attached should be of the best quality, and it will be most conducive to the health of the animals if it be regularly taken out when it gets foul, and fresh added. The bedding of the yard should also be looked after. This, however, is trodden down into manure, so far as that of the yard is concerned; but still that should have its fresh supplies of clean and sweet straw, not the musty, ill-flavoured stuff which is too often given to stock, and which has anything but a healthy influence upon them. The water supplied to the troughs should also be of first-rate quality, kept clean and free from all extraneous substances. Where the water supplied to stock is bad, it is impossible to have them in good health and condition. Young dairy stock are also housed in byres or shippons on the stall system, which, perhaps, is that which gives the best results. But whichever of the two be adopted, it is beyond all question that the wintering out in open pastures, or "hardening," as the system is often not very inappropriately called, should be given up wherever good results are desired. It is not easy to find terms sufficiently strong to condemn the silly and cruel system—silly, for, if it is difficult to see how any one, no matter how much wedded to it, or with his better judgment warped by prejudice, can believe that it is good to deprive animals of proper supplies of food, the system must be bad which does this. And its evils are increased by the cold to which they are necessarily exposed in the open fields during the severest months of the year, for the food, such as they do get, is drawn upon to keep up the warmth of the body, which would, if that were otherwise supplied, go to promote its growth. Be it always remembered, also, that the animals are just at that early stage of their progress at which proper supplies of food, and of the best kind, are absolutely essential in order to promote the growth of the various parts of the frame, and to keep up the supply of healthy blood. Now the starving wintering system is directly opposed to all those essentials; and it is, as we have said, silly to adopt it, for it is a dead loss, and it would be an easy thing to show that not one of its assumed advantages can be realised. If, however, notwithstanding all this, it be adopted, in the interests of that humanity which knows but

of one law, from which none is exempt, let supplies of food be taken to the outlying fields where the poor animals are exposed, the grass of which, at the best, gives but poor feed for growing animals, but none at all when covered with snow, and that often hard surface-frozen. Let the water pond or trough be also daily looked to, so that, if frozen over, the animals will be able to drink through apertures broken in the ice. These counsels surely point, in their very nature, to something essentially wrong in a system which requires them to be alluded to. It is, therefore, we repeat, alike silly and cruel.

A very essential point to be attended to in the case of young dairy stock is the state of their health; and of this, possibly, the best indication is the state of their bowels. Whenever these are constipated or "bound," the excreta hard and knotty, no time should be lost in administering medicine. The simpler this is the safer it will be, and the more effectual; and we know of none which has been more universally valuable in this respect than that compounded of sulphur, nitre (saltpetre), epsom salts, and ginger. The latter corrects the more powerful laxative effects of the salts, and renders the dose generally mild. Sulphur, indeed, as a medicine of itself is one of the most valuable for stock of all kinds that we know of; we have administered it in cases where hope almost has been despaired of, and its effects have been as quick as they have been efficacious. The conjunction of this with the nitre or saltpetre seems also to have a powerful effect. It is one of the few medicines which may be given with safety in almost any reasonable extent of dose. It is difficult to decide the extent of the dose, for all depends upon the age and breed of the animal; but a safe rule is to begin with a moderate dose, and give much if the bowels be not moved. The fact is "comforting," as the man said in like circumstances, if the dose be too powerful no great, if any, harm will be done.

Another point which should be attended to, as tending to keep the animals in good health, and also greatly to make them "look" in good condition, is keeping the secretions of the skin in good order. This is a point greatly neglected, and yet it is one which as much as anything else helps to keep up the healthy functions of the system. These indeed cannot and do not go on properly where the sensible and

insensible perspirations are prevented by the filthy—for that is the proper term to be used—state in which the skin and the coat or fur of the animals are, we regret to say, as a rule kept. Matted with dried dung, covered with the accumulated dust of months, probably there from almost the date of their birth, how is it possible for those secretions to go on regularly which physiology shows to be absolutely essential to the healthy functions of the system? Careful and regular rubbing down daily with clean dry straw should then form part of the work of the young dairy stock keeper, and this will be all the better if done morning and evening. To this should be added a careful curry-combing—or if the curry-comb be not used, a hard brush—at least thrice a week done morning and evening. These operations should not be perfunctorily performed, but done with such painstaking care that the coat or fur shall shine clearly and glossily; and when that be lifted up at any part, the skin beneath shall shine in its clear red state, when healthy as clear every part of it is! All this may appear to be the mere *finesse* of dilettante dairy work, but it is not so; it constitutes in reality an essential part of it, without which that high and satisfactory condition of the health of the animals cannot be secured.

So much for some of the leading points of the young dairy stock; let us now turn our attention to the older members of the family, the "milky mothers of the herd," and these we shall take up in a desultory way just as they may happen to turn up. The first which presents itself, and it assuredly is a very important one, and has an obvious and close connection with the last subject just treated of, is the bedding and cleaning of the cows. Dairy cows are under the best system of modern management, much kept in the house, stall-fed on the soiling system even during the summer, and of course in all cases during the winter for the largest portion of the day. It is incumbent, therefore, to see to the way in which they are kept in their byres, shippons, or cow-houses. It forms no part of this note to describe the various methods of stall-feeding, or to give our opinion as to which of these is the best; sufficient only for us to say that the single stall is better than the double in which two animals are bedded, and this not merely on account of the greater ease with which the animal allows herself to be milked, but for its decidedly greater safety at the times of eating, and

when she wishes to "lick" herself, when the utmost ease and freedom ought to be given to the cow. But whatever system of stall arrangement and fitting be adopted, it is essential, as we have said, that the stalls be kept in a condition of the most absolute purity. The cleaning out must be done not only regularly but thoroughly, not in the half completed way in which some cattle-men indulge. Special attention must be paid to the gutters, so that they do not get stopped up; and both these and stall floors be well washed out with clean water, the best way of supplying which is by hose and tapped nozzle, the water being supplied at pressure where steam-power is used.

The materials used for bedding cows are now pretty numerous, compared to the old times, when straw alone was used; but whatever substance be used, it is essential that it be of the best quality—sound and sweet, and not musty and mouldy. Nothing can be more reprehensible in point of humane treatment of the cows, as nothing is more blindly wrong in point of their health, than the custom of some—namely, bedding with straw which, having been previously used for bedding other stock, looks somewhat clean and as if it was fitted for the purpose. It is wholly unfitted on every ground. The most recently introduced and the most economical way of using straw for bedding is to cut it up by the straw-cutting machine into short lengths. The advantages of using this cut straw are obvious, as any part voided upon by the animal can be lifted up with shovel, spade, or fork, and with its solid deposit be carried away at once; when long uncut straw is used, and the fork employed to remove any part of the bedding soiled by solid voiding, it is exceedingly difficult to remove it without removing at the same time a good portion of the clean straw, this being dragged out. A saving of straw is thus effected. The bed, moreover, is much more comfortable, being more uniform than the long uncut straw; and it can be spread in any thickness. Saw-dust and dried tanners' bark are of the short materials also used for bedding; of these two saw-dust is the best. The worst of both is that they take a long time to decompose in the manure heap. Of the long materials, bracken or fern, if to be had in abundance, makes a good bedding material, although rather hard, and while the leaves quickly decompose in the manure heap the stems do not. As

litter of all kinds, if left in a heap for a time, is apt to get dusty and vermin-infested, it is a good plan to shake them well out before using them, and to expose them under shelter to the air. These will greatly sweeten and improve them in quality. The necessity to shake the straw for bedding well out, and especially that for feeding before it is cut, is shown from the fact that fattening cattle and cows are alike remarkable for the carelessness with which at times they select their food, although at others they are so for their fastidiousness. So much is this the case that even metallic substances of considerable length, as wire, or steel wire, nails, and a host of substances too many to be noticed here, are swallowed with the greatest indifference; but not content with these, almost any substance or body, such as parts of rugs, smiths' leather aprons, if not too large, will be taken by them. These substances are some of them innocent enough as regards their effect upon the system, but others are pernicious and dangerous in the highest degree, causing, as in the case of iron wire, complaints or diseases which often end fatally. The worst of the matter is that the practitioner is wholly at fault, not knowing the cause, or, if knowing it, not able to trace the course of the substance. All these facts point to the importance of looking well to the straw supplied to the animals. This does not apparently accord well with what is elsewhere said as to the delicate, almost finical, way with which we have stated cows will reject food which has been breathed upon by them, &c., &c. But the two habits are quite and easily reconcilable on very slight consideration. The point is, however, of such importance, and exercises such an influence upon the health of the animals, that every good feeder will see to the clean condition of the straw, &c., supplied to the stock. Even that laid down for bedding will be looked to by him, as some of those mysterious diseases which attack stock, and which baffle the most earnest attempts of the veterinary surgeon to find them out, arise from the above-named habit alone.

While cleanliness of the bedding is to be looked to, so also must that of the vessels in which the cows get their food. Much harm is done to valuable animals from want of attention to this point, for not only do they lose their appetite in consequence of the filthy state in which they too often are, but the food itself, by being put into vessels time after time,

is seriously affected and rendered in many cases positively injurious. It is also the cause of considerable loss of food, for a cow taking a dislike to its food will not again touch it; and how sensitive they are to smells and tastes they dislike is only too well known to dairymen. The rapidity with which food is rendered useless is also another source of loss, for recent science has shown that what we call mould, &c., are but the external indications of the germs which, coming in contact or being mixed with wholesome and sound materials, give rise to an endless succession of like germs which rapidly destroy the food. We could show other reasons for keeping food vessels thoroughly clean; reasons which, in passing, we may remark apply with equal force to the keeping of all the wood-work of the stalls, of the roof, doors, and windows in a thorough state of cleanliness also. Dust, if not in itself the actual cause of disease, is assuredly a vehicle by which other causes are but too rapidly conveyed. We have already alluded to the importance of keeping the bodies of young stock clean; we need scarcely say that it applies with even greater force to the case of animals arrived at maturity, when the whole functions of which are in full operation; they will require, therefore, to be aided as much as possible by the way in which the animals are kept. And, as we have shown, those of the skin play an important part in the animal economy. All dust—and plenty of it soon accumulates if allowed to do so—should, therefore, be carefully curry-combed out between and from amongst the roots of the hair, and all heavy dirt removed from the body. The animals, kept then "body clean," are allowed to remain quietly, and that restlessness avoided caused by the continued attempts of the animals to lick themselves clean. For much of the "licking" which some seem to think natural to the animal—and no doubt it is so to a certain extent—is caused by the desire of the animal to allay the itchiness caused by the dirty state of the skin; and we have already shown how essential quiet is to the due performance of the functions of the animal.

Much has been written as to the *best kind of food for the dairy cow.* The kind of food is of course greatly influenced by the season, so that the point rests also a good deal as to the way *in which it should be given* to them. As regards the best method of consuming grass when that is in full season,

a good deal has been written, *pro* and *con*, as to the two systems advocated—pasturing and soiling; by the latter term that being meant in which the grass is cut and given to the animals which are confined in the house, with the exception of a short run daily, either in the yard or in a small paddock adjoining the cow-house. Much can be said in favour of the system of pasturing, it being apparently the most natural one; still, as regards its economy, there can be no doubt that it must give way on nearly all points to the soiling system, which undoubtedly gives the largest results with the smallest expenditure. Space does not permit us to go at all into the details of the two systems; our readers interested therein will find them fully stated in the "Complete Garden," published by the same firm which issues the present volume. With the grass cut and used in the soiling system can be, and ought to be, combined the various green or forage foods which, under a proper system of management, will be provided from the early spring up to the early autumn months and through the summer. (See a note on the subject of forage foods in the present volume.) In feeding the cows upon these cut grasses and forage plants, enough should only be given them at a time which they will be able to consume with appetite, leaving no residue. For, if too much be given them, the cows will, after satisfying themselves, begin to toss it about and breathe and salivate upon it, which when done they will not again eat it. An intelligent, observant cowman will very soon be able to gauge the appetite of the animals under his care, so that he will allow of no waste of food. Some caution is to be observed in the feeding of cows upon green foods, especially at the beginning of the season, when the change from the drier food of the winter to the succulent foods of summer is made. They should be gradually accustomed to this change, either by giving at first one feed a-day of the green stuff, or, as some feeders do, giving a portion of cut green food mixed up with the drier foods used during the winter season. The first feed of the day, when they are fairly established on the soiling system, should be either of food cut the night before, or, if cut on the same morning, it ought to be allowed to lie for some time till the wet of the dew is off it. As in the case of other feeding systems, a change of food ought to be a feature of the soiling system. When the cattle are wholly

housed during winter as well as summer, the house-feeding then takes the name of "stall-feeding," which is, in fact, the "soiling system," save that the foods are, of course, different —turnips, hay, and cut straw (or chaff, as it is called) contributing the staple, as a rule. But to these a wider variety of foods ought to be added, in the form of meals of the cereals and leguminous crops, also oilcake, rapecake, cotton-seed cake (decorticated), &c. &c. These, when added either to the warmish mash or mixed up with sliced or pulped turnips or other roots (see a note in this work on root foods for the dairy), straw, chaff, or cut hay—if the latter is not of very good quality this use of it is the best way of employing it—will form excellent food, and will have all a tendency, more or less direct and decided, to increase the flow of the milk. A warm mash ought to be given twice a day, morning and evening, but certainly never less than once a day—lazy cowmen often omit the mash for several days to save themselves the trouble of cooking—and a handful of sweet hay should be given to the cows; and this best at the "milking time," as it tends to keep them quiet during the process—a condition which greatly conduces to their giving up their milk fully and freely. As regards winter stall-feeding, the way in which the food should be given will be greatly regulated by the state of the weather and the condition of the animals; the colder the weather the more frequently should mashes be given, and the foods selected should be those having a tendency to increase the animal heat, as well as that of the flow of the milk. In all cases the supply of water must be carefully looked to, and it must be of the best quality. Excepting at calving time, and for some short period afterwards, the better way will be to allow them a supply *ad libitum*. In very cold weather the habit of some dairymen, of giving cows large supplies of cold raw roots, is one as wasteful as it is hurtful to the animals, in reducing the temperature of their bodies and the flow of milk. To prevent the turnips giving the milk the bad flavour so well known, the turnips should be given after, not before or during milking.

Much could be said of the management of the feeding of cows in pastures did space permit. Suffice it to say that much of what we have said, in a "Note" in this work, on the general management of pastures themselves, applies more or less directly to that of the feeding of cattle upon

them; to that note, therefore, we refer the reader. While cows, for reasons we have elsewhere explained, should not be kept out too late in the pastures as autumn advances, and never after September allowed to be out all night, it is in spring, when about the time when they *will be expected to calve*, that this precaution is even more important. Essential, indeed, it is, that cows near their calving time ought never to be exposed even to the chances of being visited by cold winds, snow, and rains. They cannot, indeed, be kept too comfortable in every phase of the term and in every way, and the time thus bestowed will not be thrown away upon them. Many a valuable cow has contracted disease solely through being exposed in early spring, when near her time, to one blast of severe weather—how much more when they are exposed to a continuity of bad weather. In reference to pasture-feeding, the cows should not be turned out to grass too early in the day when housed at night, as eating grass "dew-wet" is apt to be hurtful to them. The safest plan is, usually, the housing of them at night all the year round, and in summer weather keeping them up till, as a rule, the grass is dry, giving them before being turned out some solid food.

Having thus glanced briefly at the leading points connected with the feeding of cows, we now turn to that important department of dairy management, the cow while in calf.

One of the great sources of trial, and, unfortunately, too often of loss of valuable dairy cows, to the dairyman is "abortion," or "slipping the calf," as it is more frequently and popularly named. There is something altogether curious about the phases of this complaint or disease, for it may almost be so called. It comes on often without any apparent reason for its existence, and, what is worse, if not infectious or contagious, it may be said to be very "catching;" for if one cow in a herd takes it, the chances are that others which are in calf will be seized with it also. This apparently arises from sympathetic causes, for if the cow first seized with the symptoms be isolated from the others, there is every likelihood that none of those will be attacked. There have been various theories set up to account for it, but we have strong reason to believe—and physiological considerations which affect all the mammalia from woman downwards bear us out in the supposition—we say we have strong reason to

believe that much of the complaint, if this term can be applied in the case, arises from the careless treatment, and—alas! that we should have to write it against those who have aught to do with the gentle, mild, and affectionate cow—worse than cruelty too often displayed towards them. They are worried by dogs and even driven by the men when going to and coming from the pasture fields; they are ill-used in the house, being often kicked, and have cruel blows given to them by sticks, milking-stools, or handles of tools; and in a variety of ways rendered uneasy, and made to suffer much physical pain. Even when left alone in the fields they are there, from the peculiarities of the very system of open-air pasturing, subjected to much that often goes far beyond mere annoyance, and becomes positive suffering, as from the attacks of flies, gnats, &c., in the summer, and the bitter cold and the biting winds of wintry weather. We cannot, for obvious reasons, go further into the matter, save by remarking, that as physiology demands for the highest development of the woman-kind the utmost gentleness and care at such critical periods, it no less demands it in the case of our domestic animals, to say nothing of the humanity involved in the point so far as they are concerned. If our dairy cows were better and more kindly treated—for mere good living and housing do not exhaust all that they have a right to demand at the hands of their masters—we should hear of fewer cases of this distressing complaint of the dairy cow-house; of this we are fully convinced. Of course there are other causes; some being connected not only with the food itself but the way in which it is given to them, the water they drink, and the air they breathe. That the two last-named of these causes assumed here to act do actually so, and that in a more decided manner than is generally conceived of, there seems to be no reason to doubt. And of the two, perhaps the worst is impure water, although impure air is bad enough. A very practical authority on dairying states it as the result of his experience, that cows which drink habitually of bad water are very liable to "cast their calf;" and of the bad waters thus predisposing the cows to this unfortunate complaint he names those which flow over or come from the ironstone formations, and those which are rendered impure by being impregnated with stable excreta—which last is too frequently the case in farmyard ponds; and

even in the case of well-water, the wells being near the dung-stance, and the soil permitting of the percolation of the liquid sewage, as it may be called, through the surrounding soil to their interior. This, and, indeed, all other sources, likely and unlikely—the latter are not seldom found, at least by mere chance, to be not the least important in their influence for evil—of water contamination, and that one should be carefully looked after. While water passing over ironstone is stated by the author we have quoted as bad for cows, having a tendency to make them cast or slip their calves, he states that the influence is less, if indeed it exists, where water is used passing over or through the older formations known as greywacke, granite, or limestone; and, we should add, gravelly and fine sandy soils are good water soils.

We have alluded to some kinds of food given to cows as a likely cause of abortion in them, especially when in an advanced stage of pregnancy. And not only the kind of food, but the form, way in which it is given, and times of giving it, we believe to possess an influence, either for or against, according as they are or are not given and followed. Thus we incline to believe that it is a very unsafe thing to do to give cows in this condition large bulks of raw turnips or other roots, especially in cold, raw, or damp weather; and still worse is the practice, and more decided the results, where the roots are not properly matured and the green tops given along with them. It would be well, or at all events not so bad, if those tops were really given that are fresh. The weight of turnips should therefore be reduced, and in cold weather, if frozen, boiled, but not in a thin watery, but rather solid and consistent state; and along with or immediately following the roots a quantity of some concentrated or artificial food. The roots will be best given after the milking, this plan being the best we know of for preventing the milk having a turnipy flavour. While being milked it is a good plan to give the cows a mouthful of sweet hay—musty hay must be avoided as if poison, which it is to pregnant cows—or this may be the best time for the concentrated food to be given them. While munching away at this they will remain quiet during the milking process. This should be done with all possible gentleness, and loud shouting and scolding, which cows know and fear a great deal better and

more than *we* give them credit for, ought to be avoided; we need scarcely say this ought also to be the case as regards all forms of cruelty, and this develops itself in bad minds in a variety of ways.

When the cows are dried off, previous to calving, all the best cares of the dairyman will be required, and nothing should be omitted which can tend to render them comfortable—a vast deal is conveyed, of vital importance to the animals, in this peculiarly English word—and to keep them in good health. Perhaps the most important point, and that which will best secure this good health, is attention to the bowels; if these are at all constricted—and the mere form and consistency of the droppings will show this at once to an experienced eye—they should be gently opened, carefully avoiding the use of all strong and active purgatives for effecting this. Indeed, the best way will be to avoid medicine altogether, or almost wholly so, and rely upon the food for obtaining the desired effect; and of the various foods at the command of the dairyman there is no doubt that good oilcake is the best and most certain in its effects on the bowels, while it is no less useful in other respects, as tending to keep up the system and nourish the organism she carries, and now so soon, if all goes well with her, to be ushered into life. But the oilcake must be pure and good, and rather than run any risk of evil consequences which impure cake (which is generally cheap, but not always, by the way) may bring about, it will be better to use a mucilage of the linseed; this being made by pouring boiling water on the seed, placed in a vessel which can be closed with a lid, when it is put into a moderately warm oven, or near a fire for a short time, till the whole is reduced to a thin substance like glue. This may be mixed with the mash, or with meal, or given along with skim milk as a drink. This mode of treatment, if pursued for the last fortnight of the cow's time of being pregnant—the weight of oilcake given per day being from four to five pounds—will go far to keep off, if it does not in the great majority of cases, as it has proved itself capable of doing where followed out, prevent wholly, the fear and dread of all dairymen, the "milk or purpureal fever," which sweeps off so many valuable cows and in so short a time, and—what is so painful to witness to those who "like" their animals—after so much distressing suffering. It is no matter of surprise, therefore,

that dairymen are so anxious to hear of and try any mode of treatment which promises to avert this unfortunate cause of so much loss of valuable animals; nor that, in this anxiety, they use some remedies which, to say the least of them, sound very odd in one's ears when recited. Thus, in a recent discussion on breeding, when the subject branched off to remarks on abortion, or the slipping of the calf, a very eminent farmer and educated gentleman, and therefore one by no means likely to be led away by any merely popular nostrum, or "old man's saw," stated, as a fact, that since he had kept a donkey on his farm, to run about with the cows, he had ceased to have any cases of this kind—this, moreover, for a great number of years—while previous to his keeping this too often much-despised animal he was very much troubled indeed with cases of a serious kind also. To an outsider this remedy or means for preventing abortion would, as the gentleman himself suggested, be often met with derisive laughter; but the explanation is as simple as the remedy, and apparently sound. Thus it has long been held that abortion is caused by the cows eating certain herbs or plants, or at least that when they do partake of them they have a tendency to slip their calves. Amongst the plants which have a bad reputation in this direction is the thistle. Now we all know that the poor donkey revels in a feed of thistles; so much so that, give him the chance, he will leave few for any other animal which may follow upon his browsing. Then, again, at the same meeting, following this suggestion up, another eminent farmer pointed out the injurious effects upon cows, as giving them a tendency to slip their calves, of the grass known as cock's-foot (*dactylis glomerata*). Now this grass is liable to be affected with the parasitical disease known as ergot, and which is the disease *par excellence* of the grain of rye; and this ergot of rye, whenever partaken of by cows, almost certainly causes them to slip their calves, or gives them a strong tendency to do so. These facts point to causes which have, we fear, been too much overlooked in the economics of farm-stock keeping. The truth is, we know very little, and, from the general apathy existing on the subject some seem to be desirous apparently to know less, as to the laws which regulate feeding, what the effects are of certain foods, and how far the natural pastures are, or are not, fitted to keep the animals partaking of them

healthy, and at the same time up to the highest point of productive capability in the giving of milk.

Supposing that the cow has passed the critical time when abortion is likely to happen to her, and that *the time of her calving* comes on, we have, in conclusion, a few words to say on that important subject. As on all others connected with dairying, much could be said on this did space permit; but we shall confine our remarks to one or two points only. Generally speaking, the parturition of the cow is easy, and not attended with danger; but nature, in place of being well assisted, is often most cruelly abused, to the detriment, and indeed frequent loss, of the cow, through the extreme ignorance of some who unfortunately have the management of dairy cows. These put in practice antiquated notions, before, during, and after calving, which are nearly all calculated to do harm, while some of them are positively cruel. What is wanted, more than all the long list of such practices and notions, is kindness and care of the cow, as a rule which has no exceptions; but, unfortunately, those who do practise such things are often precisely the people who are not kind. More injury is done to cows, and the death of more than is suspected generally is caused, by this lack of kind and gentle treatment, and which often is carried up to the point of cruelty. A cow is an exceedingly sensitive animal, and shows herself peculiarly alive to kindness; she will soon learn to know the kind look even, to say nothing of the word, of her master or attendant. We write upon a point which is one not merely of sentimentalism, but one which bears upon and has a money value, for it may be taken as certain that a cow kindly treated has a much better chance of getting through the critical period of her calving time than one which is treated in the opposite way.

CHAPTER VIII.

WORKING OF SUBURBAN MILK FARMS BY COMPANIES—GOVERNMENT SUPERVISION AND THE FACTORY SYSTEM OF WORKING.

THE acquisition, arrangement, and working of suburban milk farms may be made by men of wealth by purchase of the property, or held by tenants on long leases and on liberal terms, to induce a due expenditure, which should, however, be no way pushed beyond the bounds of common prudence. These occupations will be thus within the reach of a comparatively moderate capital, and will afford an agreeable employment for persons who have been accustomed to rural labours, having an access to urban connections. The milk farms will include a portion of arable lands, with a garden for change of attention, for the gratification cannot be small in affording one of the primary articles of food to fellow-creatures of all classes.

Companies may also be formed with ample means for the purpose, both of purchase and of practical improvements, under the agency of sufficient skill and judgment. But companies are mostly monopolies for the purpose of gain, and devoid of the spirit of benevolence that should shine in a greater or less degree in all the employments of men. In any manner or mode of holding the lands for use, a power must exist for the purpose of supervision and command, that the object be specially

performed, and that the primary intention be most strictly fulfilled to the fullest possible extent. In order to effect this object, the power may be vested in the Government by means of qualified agents to advise, direct, and superintend. Government may become the chief agents by making the farms thoroughly complete for occupation in every function that is required, in every primary improvement that is necessary, in buildings, roads, and fences, and in all fixed articles that are beyond removal, leaving to the account of tenancy the apportionment of articles that appertain to movable purposes, an interest being charged on the money at a rate which will repay the loan in a certain number of years, and leave the property unencumbered. Or the Government may become sole proprietor and tenant, managing the farms by means of agents, who will see to the special purpose being performed. If money be lent on the security of the property in the total amount of expenditure, the rate of interest charged must not exceed a very moderate rental of the land in ordinary lettings; and when the interest and capital have been repaid, an acreable rate should be imposed in the amount of rent for the value of the land. The wages of labour to be in every respect doubled from the diminished rental granted for that purpose, so that in addition to milk being delivered in a superior condition as to quality and punctuality, the means will be afforded and used of raising the condition of the labourer; an exertion of benevolence, a ray of divinity, that dignifies human nature. Kindness is the grand lever of all social and intellectual progress, and the grand secret in the sensible direction of human beings. It has been not unfrequently suggested, and the present case exhibits a fair opportunity of repeating the idea,

that all articles sold for food be valued at a fixed amount according to scale, and that the several portions be awarded to the different partners in the production, on the principle that nothing which can be fixed be left to the uncertainty of chance and accidents and of the ups and downs that prevail in all the undertakings and business of men. A fairly calculated value being imposed on the consumer, the amount is apportioned to the producer, and to the agency and costs. Milk being fixed at 6*d.* per quart, twopence, or one-third or one-fourth parts of any fixed price, may go to the retailer, leaving 4*d.* or 4½*d.* to the proprietor. This arrangement will give an equable portion to all parties, and remove the chances and losses of ups and downs, the rises and falls that happen in all human affairs.

It is the duty of every government of civilised beings, who enjoy any degree of a settled order of society, to provide maintenance for the people in competence and comfort, a national and universal education, with an established religion of national faith, derived from the use of capital employing labour with an adequate remuneration; and that as living must precede learning, it is a bounden duty that the primary and essential article of food be afforded and allotted by the unerring rules of justice and sober sense. A starved people in a state of virtue have never yet been seen on the face of the earth, and the different conditions of the human race afford most ample evidence that there is a very small distance between victuals and virtue, which mutually produce each other, as victuals foster a good conduct and a good conduct procures victuals. Every matter is an object for legislation which has for its object the well-being of man, and for which reason can assign just grounds. As before observed, there ever exists a most

powerful magnetic intelligence between mental and material food, and the former is always retarded or advanced in proportion as the latter is scanty and meagre or abundant and comfortable. A clean, wholesome, and nutritious diet of well-prepared food will always be found to be the base of human conduct, and the grand lever of all moral and intellectual progress.

New Movements in the Dairy Practice of Great Britain. The Factory System of Working.

That some important steps must be taken by those interested in the dairy farming of Great Britain is abundantly evident from the signs and symptoms which are everywhere to be met with, and unless very great improvements are made in the practice of the dairy, and that speedily, the trade will, as some think, apparently leave us altogether. That it has largely left us already is but too true, this being, perhaps, more specially the case with cheese. In this department the skill of bygone days seem to have fled from some districts almost wholly; one county once celebrated for this dairy produce being now just as celebrated for the lack of it. Cheese in mere bulk or weight is no doubt being made just as much, if not in some districts more than ever; but it is of such a quality that the price obtained for it does not pay for the material and the labour. Hence it is that milk is now sold simply as such, better profits being generally obtained from disposing of it in this way than by making it into cheese or butter. That the fall in the price obtained for home-made cheese arises from or is caused by carelessness in or indifference to the methods used in its making, is clear from the fact that really good cheese still fetches high prices and meets with a ready sale; while the prices obtained for cheeses of poor quality have for some time fallen, and are still as we write falling, in the market. We have already alluded to the efforts made by the dairymen of North America, both in the United States and in our own colony of Canada. These have been of no common kind, and have proved how much they were in earnest to make cheese and butter of such a quality, that the average would

be above that sold in this country and made here. That they (the dairymen of America) have been well repaid, is proved from the fact that the sale of their cheeses in this country has very much increased of late years, is still increasing, and that the prices which their produce brings in our markets are steadily going up; a marked, but not to us a very gratifying, contrast to the gradual decadence of our trade, and the lowering of the prices met with in it. It is, however, pleasing to be able to record the fact that our own dairymen are at last beginning to put their shoulder to the wheel, and seem determined to bring back the trade to its former point of high position by exercising the utmost care in the various processes, by the introduction of the most approved appliances and methods of manufacture, and, further, by bringing the powers of "association" of interests to bear upon the whole subject. This has taken already one outlet in the establishment of factories for dairy produce; and a further outlet has been recently established by the organization of a dairymen's association. Under the auspices of this, meetings will be held from time to time for discussing practical points, and eliciting the opinions of various kinds, and a journal has been established to serve as a medium of communication between parties interested in the trade and in all the branches of dairy farming and dairying, and as a means of bringing together and recording for ready reference various suggestions. We believe that much good will arise from the new movement; it is one to which we wish all success. That to the factory system of dairy working there should be great and grave objections made by some, and many of whom both by their position and practical skill are fairly entitled to make them, need not be matter of surprise to our readers. It would indeed be a singularly successful system which at once and decidedly took such a position that no fault could be found with it; but while faults are found by practical men, it is only right and fair that those, apart from other considerations, should be examined to see whether it be that those faults are well founded and the objections based on fairly accurate data. Judged in this way, it certainly is the case that the list of objections is not only rather a long one, but that they are, or seem to be, grave and accurate. We might go very thoroughly into this part of

the subject, but we do not consider this necessary for our purposes; sufficient will it be for these if we take a general glance at it. And the matter for this comes most fortunately to our hands from those of one who is in every respect from his practical ability as well calculated to know what the objections are, whether well or ill founded, as he is able to state them clearly and definitely; we refer to Mr. J. C. Morton, who takes up the subject and exhaustively treats it in his paper in the *Journal of the Royal Agricultural Society* of England. Of what Mr. Morton gives, we purpose presenting here a brief notice.

The first objection which one meets with bears on the face of it much that is of vast pecuniary importance and social interest. When we consider the number of dairy farms and dairies scattered throughout the country, the number of people engaged in the practical working, and, as a necessary result, the large expenditure involved in a variety of ways, one is rather apt to be startled by a system which proposes to set this all aside, or at least to alter so materially the directions in which much of it runs as to involve heavy loss and much social disarrangement. But on an examination of the whole circumstances of the case, it appears to us to be very similar in its details to that of the hand or home weaving systems as once universally carried on and the factory system of the present day. For there can be no doubt, judging from what has been done, is doing now, and is likely to be done still more extensively, that the produce of the factories is not only more quickly and economically made, but that when made its quality is very considerably higher. The result, therefore, would be, that just as the home system of making cloth had to give way to the factory system of producing it, so must—if natural laws, or what appear to be such, are to be allowed to operate in this case—the home-made butter and cheese give place to that more quickly and better made at the factories. We might have quoted what Mr. Morton says on this point at length, but these remarks of our own will be enough to show how Mr. Morton disposes of this, the first objection. But under this head there is what may be called a subsidiary objection held by some, namely, that by doing away with the home dairy system, injury will be done to the permanent interests of agriculture, inasmuch as there will be no inducement on the part

of landlords to improve their properties by the erection of new and proper buildings; to which Mr. Morton deems it a sufficient reply, as we think it is, by stating that in other callings, such as that of manufactories, if one party outstrips his neighbour by reason of his better appliances the other must either adopt them or suffer the natural loss, so with landlords of property in land. A second subsidiary objection is that, seeing some landlords have put down expensive buildings to improve their dairy farms, it is a pity to introduce a system which would render these useless, or nearly so. The reader will see the single, simple, and obvious answer to this.

We now come to the second class of objections named by Mr. Morton, which is, that in connection with dairy farming, pig-keeping is, as a rule, carried on, and that the manure obtained from these applied to the land maintains its fertility, and thus promotes the general agricultural value of the country. It is right here to point out, that although great diversity of opinion exists amongst dairy farmers as to the value of whey in connection with pig-feeding, still the evidence of practice shows the value of the system. Mr. Morton, seeing this, admits that the objection is a valid one, and constitutes a real difficulty in the factory system; but he believes it will not be considered fatal to it, for the whey will either be brought back to the farm from the factories, or be sold at the latter, or used there in piggeries. So far as the loss of a source of fertility to the farmer is concerned by the whey no longer being available to him, Mr. Morton states that this difficulty will or can be got over, precisely as in somewhat similar circumstances where other sources of fertility are disposed of, but which the intelligent farmer can do in the case of pig-manure. In some cases the value of the whey and its consequent manure is increased by using largely and liberally other foods along with it; Mr. Morton, quoting the case of one farmer who purchases yearly no less an amount of meals and other foods than £300 per annum, setting the highest value on the whey, and declaring that without the above expenditure the "deterioration of the fertility of his farm would be inevitable."

The third class of objection is, that the factories need not count on obtaining supplies of milk from the occupiers of those farms who make the highest class of cheese, and obtain for it an average price higher than that of the average

price received at or from the factory; to which Mr. Morton replies, and truly, that such high-class dairy farms are the exception, and by no means the rule. It ought, moreover, seeing this is the case, to be remembered that there is an enormous advantage to all classes in having the milk of all second and lower rate farms worked at the factories into the highest class of produce possible to be made. No doubt this answers the very point at issue, according to those who if not opponents to are certainly not supporters of the factory system, namely, that by it this end, the highest quality possible to be made, can be reached. All experience up to date, however, proves that it can be so, and it is likely or natural that it should be so; for in other manufactures, the larger the amount or quality of material dealt with, the more complete and perfect are the appliances, and the more these are used, the better the quality of the ultimate produce manufactured; and as with other branches, so will it be, as indeed it has been, and now is, with the dealing with milk on the large scale.

The fourth and last class of objection, which Mr. Morton very justly deems an important one, namely, the cost of carriage from the farm to the factory of the milk, as well as the additional labour incurred in sending it—an important item on all farms, and, therefore, not lightly to be considered. Practically this will, in process of time, right itself, and when factories increase, taking in the milk of larger and more numerous areas or districts, the cost will be reduced to a minimum; even at present the difficulty is not deemed insuperable. The advantages of the *cheese-making* factory system are not proposed, as admirably stated by Mr. J. C. Morton in his able paper, to be extended to the care and keeping of the milch cows; if, indeed, they are, or can be, applied to such. As this eminent authority puts it, the prosperous condition of the animals can only be secured by the advantages flowing from direct ownership, and the constant personal care and anxiety which this alone can ensure; in short, as we may say, nothing can compensate for that exercise of individual care and close personal intimacy, so to put it, which should subsist between each individual member of the herd and the assistant upon whose attention it depends for food and all those minute and attentive cares which alone can make it a healthy and

paying animal. (See our Note on the General Care and Management of Dairy Cows.)

But when with Mr. Morton we consider that according to his estimate 200,000,000 gallons of milk are converted in this country into butter, to say nothing of the enormous quantity also formed into cheese—a quantity, so far as cheese-making is concerned—equal to an equivalent weight of so many pounds; and when, moreover, by the improved method of making which the factory system brings with it we consider the increased value equal to at least 10*s.* per cwt.; and when, in addition, we think of the fact that the labour of at least 10,000 dairymaids, working in home dairies in isolated districts, is done away with, setting this large amount of labour of the highest class as regards activity, cleanly habits, and high moral status free for other branches of labour;—it is impossible to look upon the extension of the factory system with any other than feelings of the highest interest, and with the most anxious wish that it will be so eminently successful that it will form part of the regular dairy economy of the United Kingdom.

The manufacture of cheese, and in a corresponding degree that of butter, in the factory system is one, as our authority remarks, which depends upon the behaviour of the raw material under the well-known processes to which it is subjected. There is nothing, he continues, to take it out of the risk of ordinary manufactures; nothing to hinder us from anticipating that the greater economy and profit of operation on the greater scale which are realised in these, will not be realised in this. In a few plain but forcibly graphic words, he contrasts the system pursued in home dairies with that pursued in a well-managed factory; pointing out that to any one who "comes into the dairy, say even of a two hundred acre farm, during the last two months of the cheese-making season, and sees the little mass of curd lying under its cloth in the cheese but just ready for the press, the whole daily result of all this great apparatus of milk-room, cheese-room, boilers, ovens, dairymaids, and what not, which has to be maintained, it must seem plain that the factory which unites the work of thirty or forty dairies in a single apartment, with one, two, or three hands for the whole of it, must ultimately succeed on the score of economy and profit."

Those are weighty and pregnant words, and are in the main true, but we must not overlook the fact that the circumstances under which a factory is established will materially affect its prosperity. The great point to be arrived at is so placing it that the concentration of the milk of many dairy farms of a district will be arrived at, at the least possible cost. This Mr. Morton has not, however, overlooked, but it may be so by others; and if so, a very important element of loss will be introduced into the system, and bring about a condition of matters which, not originally calculated for, will be a source of great disappointment, and may be the cause of retarding the progress of the system. In agriculture, as in engineering, all the elements must be taken into account, otherwise the calculations will be wholly fallacious.

The following constitute what may be called the *statistics of the cheese factory system*, as given by Mr. A. L. Fish, an American authority on the subject, in the paper by Mr. Jenkins in the *Journal of the Royal Agricultural Society* of England. For every one hundred cows there should be provided the space of four hundred gallons in vats to curd and work the milk. The milk-vats may vary in cubical contents from one hundred up to one thousand gallons, the size or superficial surface of which will depend upon, and be regulated by, the depth, length, and breadth of each vat, so that the floor space of vat room may be calculated at the above rate and on the data given below, according to any desired plan or arrangement. All the vats, no matter how numerous, may have their contents heated by one pipe leading from the heating apparatus. Of heating media steam and hot water are usually employed: Mr. Fish prefers hot water, as this gives, he thinks, a softer heat. The data, as regards size of vat, are as follows: usual width, 3 feet to 3½ feet; depth or height, 16 to 20 inches; length proportioned to the quantity of milk. A large vat is more economical than several small ones, as one attendant can manage it, but not the latter at one time.

As regards the *curing or drying room*, for every one hundred cows there must be one thousand square feet of floor space. The best width of the curing room is from thirty-six to forty feet. Mr. Fish, objecting to have ranges of shelves one above the other, prefers to build the curing-room in

several stories, each room to be seven feet high in the clear. As ventilation is of the utmost importance, Mr. Fish recommends the following plan. To withdraw the foul or damp air given out by the cheeses in process of drying, he has ranges of wood ventilating shafts, one foot square, placed in the centre of each room or story, at distances from each other of ten or twelve feet. These shafts are to be carried up right from lower to upper story; and to withdraw the air from each floor or room, each shaft is provided with a small trap or door, opening into its interior, at or near the ceiling of the room. The fresh air is supplied by means of a series of small air boxes or shafts passing through the walls, at intervals or spaces corresponding to the vertical air-shafts. These fresh-air shafts deliver the air from the outside at the floor level of the curing room; the inner end of the shafts to be tipped up, that is, to be higher than the outer end, this arrangement preventing the rain from entering the room. The outer ends of the shafts are cut off at an angle from the wall, the lower side of shaft being thus further from the wall than the upper. To the outer opening a trap or door is fixed, which, when let down or closed, keeps shut by its own weight pressing upon the angular end. The area of each shaft is thirty-six inches, that is, with an opening six inches square. By the arrangement of ventilation here described, the fresh air upon entering the curing-room gains admittance to it without coming in contact with the cheese-shelves or the cheeses thereon, and passing on to the central air-shafts, finds entrance to the interior of these through the doors or traps, and from thence to the external atmosphere at roof. Mr. Fish deems it essential in a curing-room that it shall be so tightly covered as to reject all outside influences at pleasure, and to be prepared to create warmth and dry air within when needed.

SECTION II.—PIG AND POULTRY FARMS.

CHAPTER I.

EXTENT AND GENERAL MANAGEMENT OF THE FARMS.

THE second circular range of suburban farms is placed at the distance of four and six miles from the depôts, that are conveniently placed in the nearest open parts of the city or town, for the use of which an arrangement is made. The articles that are required to be produced for the daily or early consumption are the next to milk in delicacy and in the liability to damage from handling and conveyance, which must be short and unfrequent as possible. Eggs and poultry are the chief products, with the delicate flesh and carcases of roasting or suckling pigs and fresh pork, of which, and of poultry, the young condition imposes the necessity of delicate handling and of short conveyances. Both these essentials must be very specially provided for. These provisions cannot be dispensed with, being the last performances in the undertaking, and powerful to damage and ruin the whole labour and expense of the business.

The lands that are situated at the proper distance from the cities and towns must be appropriated for the special purpose by purchase, or held on long leases, of

which methods of possession the former will be most eligible, as affording the utmost freedom of use, and the most contented feeling arising from the labour and expenditure devoted to them. A satisfaction is produced that is doubly felt, even though a lease contains the same security; the very words convey a sense of difference that vanishes upon a strict examination. The choice of lands for the special purpose is not easily obtained, as the locality and position fixes the application, and their purpose cannot be changed. Inferior lands must be made fertile by the mode of general improvement that has been described, but which must be recapitulated in all such cases in every detail, as they constitute the foundation of every successful cultivation of land. Wet lands must be thoroughly drained by trenches or cavities two and a half to three feet in depth, and about five yards apart, filled with broken stones or arched tiles, with a surface covering of fifteen inches, to permit spade digging of the ground in ten inches deep. This performance is the essential preliminary in all cases of wet lands without exception. The entire area is proposed to be dug by spade, and inlaid with lime cinders, placed on the breast of each spit at the rate of one hundred bushel of cinders to each acre. The moisture in the soil will dissolve the cinders, when the caloric that is evolved will penetrate every particle of earth, sunder the atoms of cohesion, and thoroughly burst and break the texture of the soil, producing a fineness of condition, and preventing the future cohesion of any soils, even of the most waxy clays of the marine formations. The soil will be warmed by the heat of the lime, and incorporated with the earthy base of the lime in the form of a soft tilth. A double benefit

is derived by the temperature of the ground being raised and the body of the soil enlarged in the earthy constituents by the addition of carbonaceous matter. The thorough draining, the deep digging with mixture of lime, constitutes the foundation for the action of future applications of manures, which, in the present case, will consist in farmyard dung of straws and excrements.

The breeding, rearing, and fattening of poultry and pigs being the whole employment of this class of suburban farms, the business will very much partake of housewifery, and will be apportioned in extents to suit the tastes and conditions of that class of persons who occupy that station of life best suited for the drudgery of the business, which appears a lower step in the employment of farming. An opportunity will be afforded for the use of small amounts by persons who have arisen from the state of common labourers with a sufficient though small capital, who possess the inestimable privilege of enjoying the knowledge of labour in the acting and in the direction of it. This class of persons is the most valuable of all the various grades of society, having the power of knowledge and the capability of increasing the value of the possession. It forms a large step in the advance from a lower to a higher station in society, in the meantime performing a most valuable part in the production of the necessaries of life. The size of the farms may be averaged in the extents of fifty to one hundred acres, to be cultivated wholly by the spade, as only one horse and cart is kept for the purposes of detail work. The other implements will be few, and easy of purchase, in wheelbarrows, forks, and rakes, and some similar utensils.

Potatoes are a choice food for pigs and poultry, and

for human beings the root is almost indispensable. The produce is large, and the cultivation on almost any soils is easy and comparatively simple, and the mixing of lime with deeply dug earthy formation of almost any quality reduces its nature into the necessary adaptation for the growth of tubers in the depth and moist warmth of the alluvial composition. Raw or steamed, the roots are almost invaluable for the present purpose, and it will be required that the one-half part of the farms be used in producing potatoes with a portion of the fallow ground in growing Swedish turnips and mangel-wurzel for a change of diet to the animals, and chiefly to those in the fattening condition. One-fourth part of the lands will grow oats and barley as food for the pigs in raw grains and in ground meals, and in providing straws for litter for the sties and yards. Oats are very useful in meals and soups for young pigs and brood sows, and in the raw condition for feeding poultry, and a part will be required for the work-horse. No better food has yet been found for the rearing and fattening of poultry than the tailings or light grains of barley and oats. Wheat has not yet been introduced in any condition as food for animals of any kind, and no portion therefore of that grain is grown on the farms. Pease and beans are grown on the root crop preparation of the land, along with oats and barley, as the grains are very valuable in pea-soups for young pigs, and beans in the raw condition being given to bacon hogs in the last month of fatting, for the purpose of imparting a firmness to the flesh and a delicate whiteness of colour. The difference in feeding value does not appear very satisfactory between the raw state of grains and the condition of being split, bruised, hashed, or ground into meal. The value of soups is not questioned; their fatting condition

may be doubted. The clovers and vetches will be required for the summer food for the horse and two cows that are kept for domestic purposes, of which a portion will constitute the dried provender for the winter keep. All these crops are produced in the alternation of grain after root crops, and the legumes after grains; and as no fences or roads are required, the lands can be divided into any number of plots of land, and of any size, to allow the regular succession of the plants. The cultivation of the lands will be best done by spade digging, which will impart the benefits that are supposed to accrue to the land from that mode of preparation over ploughing, and much in placing the soil in a more open position to allow the fermentation of air and moisture; but it will increase the quantity and the wages of labour, although with an extra produce to balance the expense of digging over the cost of ploughing. The land will be rendered doubly productive in the essential necessaries of life, a most desirable consummation in a country with an increasing population; and along with an increase of labour with a corresponding remuneration, it constitutes a recommendation for the system which requires no argument to establish its worth, or of any comparison to show its superiority.

These farms are reduced in extent to suit the small purposes of general farming, and to employ the lesser amounts of capital in the hands of the most useful industry. The special employment of land, labour, and capital is a market farming to procure the smaller articles of daily and most constant use; just as the market gardening produces the vegetable articles for the same purpose, and in the similar classes of the wants to be supplied. The employments are similar, and are placed in the same range of position, differing only in the

nature of the articles, and not in the means that are required, or of the treatment of the land and of the produce. Gardening is only farming in the superlative degree, with the privilege of enjoying a superior entertainment and a separate living in the division of arts; though a very close resemblance exists in many points of performance. In both cases the land must be highly fertilised and kept in that condition, the gardening not being self-supporting by the production of manures, but requiring a heavy expenditure in the cost of that article. Farming, however, may be made wholly self-supporting from the animals that are bred, reared, and fattened on the produce for sale, and in this respect the management is less costly and easier in the outlay. In market farming the arrangement must in every point tend to the condition of self-support, which will direct that roots and straws be procured in the utmost possible quantity, and that the number of animals that can be kept be strictly apportioned to the means that can be raised from the lands for their maintenance and the fattening. If any articles are purchased, straws and litters will be most useful for being cut into short lengths by hand-cutters, and spread thinly and evenly in the store-yard of the pigs, and mixed with the saponaceous excrement of the animals, which are most excellent manufacturers of manures by the constant turnings and tossings with their snouts in search of grains, and from the quantity of urine voided from the juicy food of roots and legumes. If necessary, manures in vegetable and animal refuse may be procured from the cities and towns, and carried on trucks by railway that leads to the farms; and if in want of a further decomposition, the littery materials may be placed in the store-yard to be very beneficially mixed

with the cold and saponaceous excrement of the pig. A most excellent manure may be produced by this mixture with attention to the spreading of such substance in thin layers, or only over the surface of the store-yard, of which the bottom must be formed in a coved shape, so that the moisture rises evenly on all sides of the concavity. In every properly arranged system of cultivating lands, the roots, hays, and straws are consumed and changed into flesh and manure by the animals that form the organs of transmission. The number and quality of such agents must, however, be very correctly adjusted.

There is not a more important point in the whole range of social economy than the employment of labour, and the remuneration of it, from works of present value and utility, and for the future benefits of the community. Among the many occupations that may be devised for the exercise of mind and body, and for present and future weal, no single one, nor any number of them, can be estimated in superiority, or even placed on an equality, with the employment of agriculture; in the distribution of capital for the various purposes of its use, in the exercises of mind in the fulfilment of the intentions and works of nature, and in granting a livelihood to labour, which is the foundation of stable and conciliatory arrangements of society, of which contentment must form the links, and affection solder the joints and tighten the ligatures. Without a foundation of firmness no building will stand in safety, and without a base of the essential and most absolute comforts of life no society can ensure stability, nor can any virtues abound.

The farms now under consideration require an accommodation for the living and dead articles of service that

is in proportion to the extent of the land and of the amount of capital and of attention that is expended in the undertaking. The dwelling-house (see Figs. 9, 10,

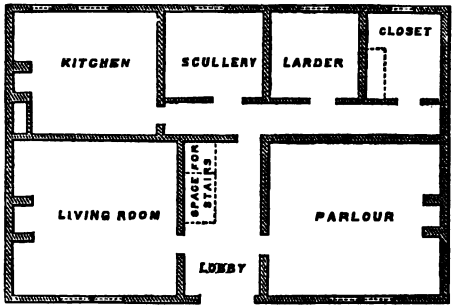


Fig. 9.—Ground Plan of Farmhouse. Scale 20 feet to the inch.

11, and 12, 13, 14, 15, for plans and elevation of two designs) of the occupier must provide a lodging to accommodate a domestic circle of the average of seven

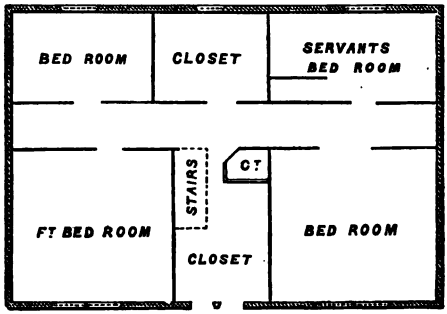


Fig. 10.—Bedroom or Second Floor Plan of Farmhouse in Fig. 9.

or eight persons. A length of forty feet and a width of twenty-four feet will afford two rooms on the ground floor, with an intervening passage of eight feet leading

to the back parts of the house, in a kitchen, a scullery, and a pantry. A height of side walls of twenty-two feet will allow bedrooms in a second floor in four apart-

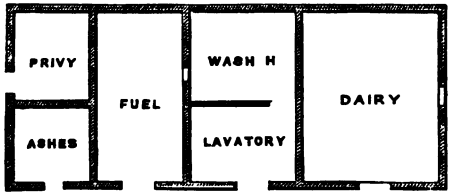


Fig. 11.—Plan of Outbuildings for Farmhouse in Fig. 9.

ments, to which a stair leads from the passage in the front entrance. The servants' bedroom is reached by a stair from the pantry. The rooms are all ceiled

Fig. 12.—Front Elevation of House in Fig. 9.

and plastered in the usual way; the best front rooms papered, floors laid with deal; back apartments paved

with flooring bricks. The exteriors of the house are done in the old English style of building, which is in all cases adopted, with the corresponding shape of

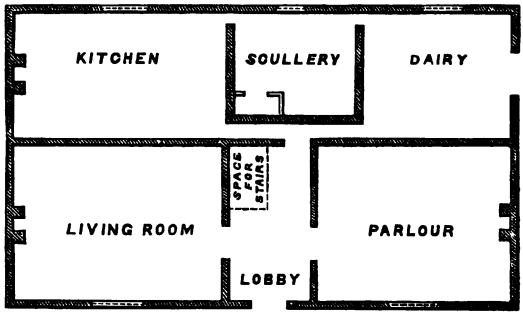


Fig. 13.—Ground-floor Plan of Farmhouse. Scale as in Fig. 9.

doors and windows. A front porch is introduced in order to break the uniformity of dead straight lines. It may be made very plainly ornamental and in-

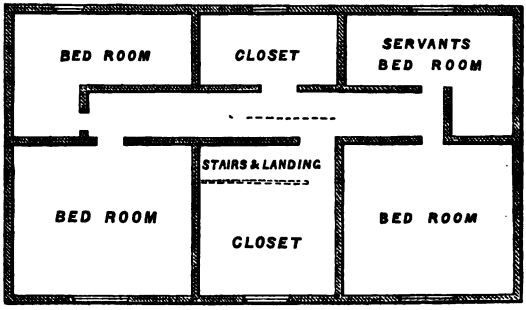


Fig. 14.—Bedroom or Second Floor Plan of Farmhouse in Fig. 13.

ternally useful in having shelves on each side for the placing of small articles.

Even in the lowest arrangement of labourers' cottages, some small back buildings are most essentially necessary

for dirty work, and to conceal things that never should be seen, in order to preserve the cleanness of the chief dwelling. This necessity increases with the gradations of the station in society in which civilisation advances, and from which examples must be taken for practice. In the present case, the small buildings in common use are placed some few yards of space behind the dwelling-house in the same length of forty feet, divided into four or five apartments for coals, ashes, wash-house, a privy, dog, and lumber—the privy to slip the excrements by a stream of water through a glazed pipe into the ashpit, there to form an excellent manure in an earthy calcined putrescence saturated with

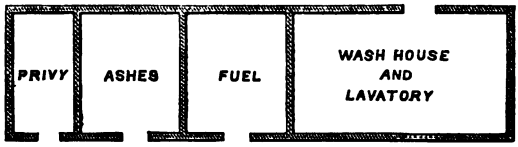


Fig. 15.—Plan of Outbuildings for Farmhouse in Fig. 13.

urinary and solid fæces. A pump will be sunk in the back yard, which supplies all the wants of water over the establishment, the dwelling-house, the labourers' cottages, and the farmery of pigs and poultry, by means of diverging pipes underground, conveying the water by shutting the upper valve of the pump, all the conveying pipes emanating from between the two valves of the raising power. This provision of a copious supply of water is the very foremost convenience in all human dwellings and their attachments. This area of small buildings has walls of a height of eight feet, and the roofing and doors are made to correspond with the plain style of the dwelling.

Two or three cottages for labourers may be required

in each farm of the pig and poultry description, and erected in the neat and substantial mode of a plain and not costly elegance, combined with a constant and steady regard to convenience and utility. In the plans of such dwellings three requisites must be observed and never omitted—two apartments on the ground floor, or a kitchen and a better room, three sleeping apartments at least on second floor, and some small buildings behind the cottage for the use of the smaller purposes and articles that are attached to all human habitations. A length of thirty feet will permit two apartments and a front passage, and the height in sixteen feet of side-walls will give comfortable sleeping apartments on the second floor. Walls plastered as usual, floors of deal boards, and the ground floors paved with stones or flooring bricks; the exterior ornaments in the plain old style. (See Figs. 16, 17, 18, and Figs. 19, 20, for plans and elevation of two designs for cottages.)

It is most essential that all constant labour be lodged on the farm under cultivation, for the purpose of hand-work and the care of animals. The keep of a cow as a part of wages is most beneficially arranged, as for a young family the milk admits of no substitute whatever. The fattening of a pig is also very advantageous, and two animals yearly afford a ready and nutritious diet at all times and in all seasons. A quantity of potato-ground as a part of wages produces food for the pigs, and a piece of garden ground is attached to the dwelling of 600 to 800 square yards for the growth of the common vegetables of the early growths. In these situations milk cannot be got for money, nor can potatoes be obtained so very easily and readily at command, while a ham or a flitch of bacon hanging in readiness for any occasion or demand will do more to prevent

marauding and poaching than all the penal statutes that ever were written. Peace and virtue are not far distant, and neither of which can be obtained without competence in the necessaries of life in the quantity and quality usually required by that class of society

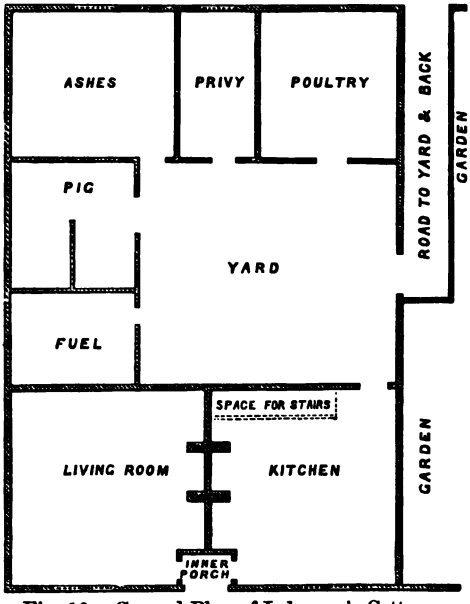


Fig. 16.—Ground Plan of Labourer's Cottage.

which lives by labour. In such farming arrangements as the present, made for the purpose of enlarging the supply and the convenience in use of the most essential articles in the daily economy of human food in addition to the ordinary wages, it is worthy of consideration whether the workpeople should not have a part of the profits and income from the realisation of the scheme, tending thus to form and keep up

a strenuous goodwill for its success. This last most valuable quality is only to be got and upheld by the contentment and affection of the labourer, having

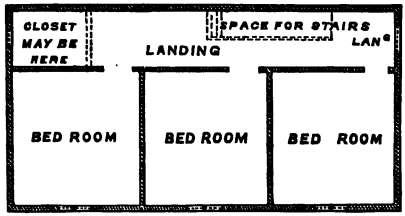


Fig. 17.—Bedroom Plan of Cottage in Fig. 16.

a proportionate share of profits awarded to his labour in the amount of provision and in the accommodation necessary for enjoying its value. The morality

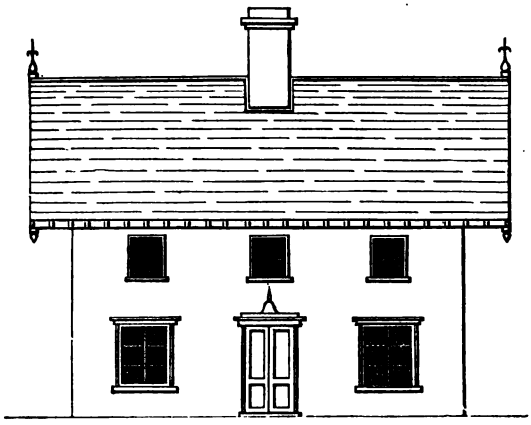


Fig. 18.—Front Elevation.

that flows from peace and contentment, and the continued willing and steady efforts to sustain these acquirements, must not be overlooked in any estima-

tion of the expected benefits, as those in view are fully equal, if not superior, to the returns obtained for the use of the capital that is employed. Moral strength is always in a high ratio above the physical, and general society is formed and maintained by the united affections of its members. If these units of support be loosened or removed, the whole fabric must tumble to

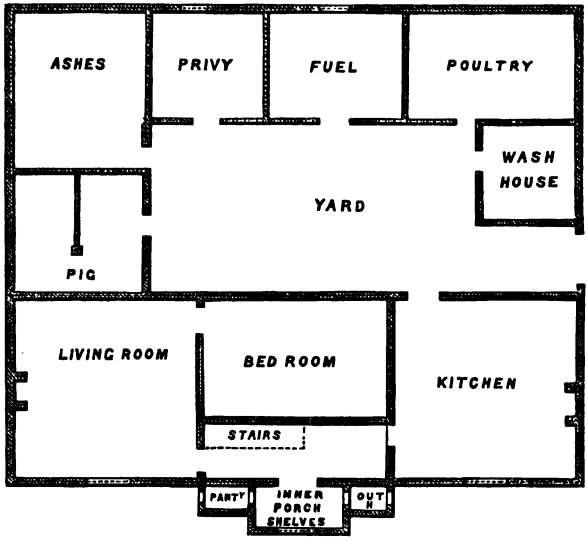


Fig. 19.—Ground Plan of Cottage.

the ground, as specimens of human folly and ignorance. Such are mostly all the edifices of human construction —based on selfishness and reared by conceit and ignorance, founded by chance and accident, and continued by a grasping and individual monopoly.

Benevolence is by far the brightest jewel in the diadem of intellect, and contains all the sources of that

sympathy and social feeling which gives the zest to every rational faculty of the soul. The want of it hardens the heart and petrifies the feeling, and converts the ray of divinity that dignifies human nature into that from which any spark of benevolence is hopeless as a thaw in Zembla. Man resembles the Great Creator of all things in nothing so much as in doing good to his fellow-creatures, not only in charity and almsgiving and the relief of general wants,

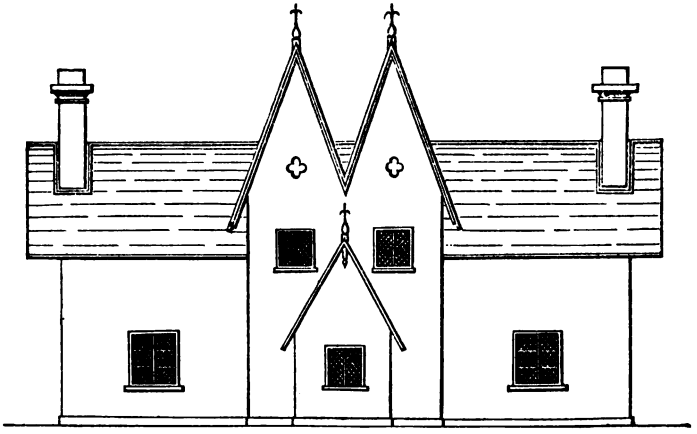


Fig. 20.—Front Elevation.

but in that universal benevolence which comprehends the whole human race, devises schemes to better their condition, and labours incessantly for their present and future good. This is an employment that angels may not only desire but yearn to be allowed the participation of. It is the summit of all duty and the last of all obligations.

Power, supreme or small, majestic or gentle, is ever to be manifested by its benefits, as the use of it is the

only advantage of having it, and nothing so readily and so fully displays the human character as any power over its fellow-creatures, when it is soon disclosed by the words and actions of general conduct. Power should gather respect, not hatred—conciliate affections, not raise discord; happiness consists in loving and in being loved; the duty of it must not only scatter benefits, but strew flowers for the sake of fellow-travellers on the thorny path of this wretched world. The use of money is the only advantage of having it—an idol worshipped in every clime without any temple or one single hypocrite. A heavy responsibility rests on those persons who have both the means and the power of making every breath to be perfumed with kindness, and of dispensing the benefits and blessings of competence and comfort. Kindness is the grand lever of every social and intellectual progress, and of every success in the management of human nature, ever making a sunshine in a shady place. Benevolence is the best interest of every man by the constitution of the world, and the royal road to every individual as well as to social happiness.

CHAPTER II.

BREEDING OF PIGS, THEIR POINTS AND PECULIARITIES—PLANS OF PIGGERIES AND METHODS OF STOCKING THEM.

Pigs form the chief produce of the special farms now being described, and the best articles must be selected for the use of the establishments. Swine may not be indigenous to the British Isles, but the animal was noticed by the earliest writers as a wild beast of the chase of which the extinction is uncertain in point of date. The pig had been domesticated when records began to be made of agriculture, and is described as a useful animal of the farm, very different in many points from the native wild animal of the Alpine countries, where it is yet found in the original state of natural production. The best lowland hogs of England were large in bone, long in the limb, low on the shoulders, narrow and curved in the back, uniting every objectionable point, and totally devoid of any approach to symmetry. The shape was most uncouth, and the face almost wholly hidden by the long slouching pendulous ears. The animal consumed much food, and fattened slowly; but the prolific quality produced a numerous progeny, and the swine had an abundant yield of milk. Many varieties of this general and originally sole description of swine had appeared in the descent from the wild hog, as each locality of soil and climate had formed for itself a variety which bore

the permanent marks of external impressions. The entire general appearance of the hog indicates a strong tendency to fatten and to accumulate flesh. When the large improvements in agriculture commenced in Britain more than a century ago, swine were observed among other articles of the farm, and the improvement was obtained by the same rules as in the case of the other domesticated quadrupeds. The best forms of the animal were selected for propagation, in the tendency to fatten early and in the quantity of flesh, in the shorter legs, flatness of back, and the loss of the huge and pendulous ears. These points being observed and practised, gradually produced a great alteration in the animal frame, in lessening the bulk of carcase, and in improving the general conformation.

During the progress of improving the breed of swine in Britain much advantage was derived from a cross with the foreign breeds of Naples and China, which had procured a variety that possessed many points of excellence, as the delicacy of flesh which is produced in warm countries and the adaptation of swine to circumstances is great beyond any other animal of domestication. The coarseness of shape and flesh was reduced by the infusion of Asiatic blood, as the Eastern hog is delicate both in constitution and in the muscular fibre, and very sensible of cold — not handsome in the body, which is low and trailing and white in colour, back sunk, and the hams thin. The quality of the flesh being transmitted to the progeny forms a most valuable recommendation, with a very prolific nature in producing young both numerous and frequent. The general excellence lies in the intermixture with more hardy races, from which the most beneficial results have been obtained.

The Naples pig is black in colour and without bristles—which grow in this country—legs of medium length, the body square and cylindrical, with a general symmetry far beyond any half-bred condition of animal life. The flesh is very good in quality, and the crosses with English swine have produced a breed of great fineness of form and aptitude to fatten, combining the most valuable adjuncts of bulk and quality.

The continued and progressive improvement of swine in Britain has led to three distinct varieties of animals, as affording the special articles of demand for the varied purposes of use. The varieties are in a large breed, a medium-sized animal, and in a small breed. Many modifications are found, as in all cases of organic life, but the special properties are always to be found. The large breed has descended from the old English hog by propagating from the most handsome specimens, and from perseverance in the judicious selection, and most powerfully assisted by the altered circumstances of maintenance and accommodation. The narrow erectness of the back was depressed into nearly a level extent from the head to the tail; the ribs were much curved outwards, and increased the lateral extension of the carcase; the snout was shortened, the head widened, and the long slouching ears cut into half the length. The widening of the body brought it nearer to the ground, shortening the legs and expanding the frame. The colour is nearly white, as of the original hog, but passing into black in several modifications of different bulks, with a clear evidence of the original descent. The varieties are not many, but more handy in spots of black, and in a reduced form in every point.

The large hog of the present time exhibits a bulky

carcase of an unwieldy size, with a symmetry corresponding; back still rounded, ribs flat, head depressed, with slouching ears. The breed is not in the highest repute; the chief use is in the length of carcase affording the large flitches of bacon, and the width of body adapts the flesh for cured hams of the largest size for the very important purpose of naval stores and for exportation. A class of consumers is found in the lowest class of population; the higher orders prefer smaller bulks, with delicacy and taste. The inside offal is very large, and the quantity is very far beyond the proportion of lean; the flesh is very strong in the taste, and the bulk of carcase prevents the animal from obtaining the necessary exercise for the digestion of food and concentration of the flesh. On the other side, the sows are very prolific in bearing young, and nurse them with an abundance of milk. This property, with that of the adaptability of the carcase for the supply for naval stores and exportation of suitable parts of meat, entitle the large breed of pigs to a standing among the improved and most useful swine, if not the highest position, at least in a second place of the best utility.

The medium-sized breed of pigs is the most extensively used variety, and upon the most incontestable grounds of preference. The descent has come from the best forms of the old English hog and the male pig of Naples, with its shortness of leg and the delicacy of flesh. The colour of this variety is white when the old English pig has had the most influence in the production, and black when the Neapolitan blood has been more employed. The black colour shows the most resemblance to the Neapolitan animal, and the bristles are more wanting than in the white colours. The difference of colours agree in forming by far the most

useful of all British swine in possessing the unequalled advantage of producing in the young condition the delicate article of pigs for roasting and of small fresh pork at a later stage of the young growth. The most advanced fattened age yields hams and bacon of a sufficient size, which much excludes the use of the large breed of swine that has been last described. The prolific quality is very fair to produce a sufficient offspring, the milking is ample for their maintenance, and the quality of the flesh in any condition of fresh or cured is beyond reproach. The black is the most fleshy of the two colours, lower on the legs, more compact in the shape of carcase, which exhibits probably the best specimen that can be seen of a square within a circle, the much-desired figure to obtain the weight of animals from measurement. The breed is the most generally useful of all British swine.

The small breed of pigs has been obtained from crossing the smallest-sized variety of the English improved hog with the swine of China. The delicacy of flesh has been imparted by foreign pigs, as warm countries only produce swine with that perfection. The value of the property was soon observed and appreciated, and the continued use has stamped a breed of a persistent quality. The colour is mostly white, as the descent is white from the hog of England and China; the size is small and the bulk diminutive, which is compensated by a greater number of animals being maintained on a given quantity of food. The great use of the breed consists in affording young pigs for roasting, with a large quantity of flesh on the bulk of bone. The most delicious fresh pork is also afforded by the small breed of swine; for not only the delicacy of flesh suits the purpose, but the size and form of the animal

join in forming a most eligible article for the tables of the rich, and the secondary degrees of domestic economy. For bacon and hams the use is limited; the size is below that condition for being prepared, and the flesh is too weak to be salted. The largest carcases are sometimes used in that way for future use, but the great value of the breed is the affording roast pigs and fresh pork, for which the pig is most admirably adapted. The breeding from near affinities has reduced this breed of swine to a very delicate condition; the hair or bristles have nearly altogether disappeared, and is succeeded by a scrofulous skin and a redness beyond the natural condition. This state is deficient in the natural vigour that is required to discharge the animal functions. No animal of domesticated breeding receives impressions so freely as the pig, and none is so easily damaged in the organization by the well-known effects of breeding from near affinities, which must be carefully avoided. A most peculiar delicacy attaches to the pig not observed in other animals, at least in a very minor degree. The susceptibility of the animal has a large development.

The housing accommodations for the animals of the farm that are bred on the ground and fattened by the produce of the lands, are placed in assemblage of conveniences to suit the various purposes of use, in providing the food, and in making comfortable lodgings for the animal organs that change the vegetable articles into flesh and fibre for human consumption. The provisions must be contiguous for the purposes of ready convenience, but not huddled into confusion, and wanting in the necessary room for the readiness of application. The shape of a parallelogram or oblong square is the most generally preferred, as containing

within its area all the necessary divisions of use, which must be placed so as to afford the greatest possible convenience with the least possible labour. The farms now described are purposed to produce two kinds of articles, which are thoroughly separated by Nature in every point for organic construction, and therefore must be used with a different treatment. Pigs and poultry must be wholly separated, except in the provision of food, which is similar in a few articles, and therefore the position may be adjacent for that purpose, but not mixed in the animal habits of the living economy. The piggery on the square provision of the accommodation for these animals is constituted by a large and roomy cooking-house for the food by steaming of roots both for pigs and poultry; and the house must occupy a central position betwixt the piggery and poultry-yard, which stand with the short end of the square facing each other, with the cooking-house intervening, and communicating with both departments. This house contains and provides all kinds of food, dry, moist, and liquid, which is conveyed to every place in light iron waggons on four wheels along the passages that are paved with flagstones. The house is raised to a second-floor ten feet high, of which one-half of the whole length is boarded for lodging dry grains and any other articles of use. The ground-floor is paved with flagstones, and provided with the fully organized steaming apparatus, vats, and cooling troughs, with an unlimited supply of water. The house is roomy—a most essential provision.

The three breeds or varieties of pigs that have been described are introduced for the separate uses, and are divided in the accommodations into large, medium-size, and small breeds. The brood-sows, with a boar of each

variety, are lodged in single sties with a shed and yard, with a trough and short straw for litter, and are fed chiefly with moist and liquid food, as steamed potatoes mashed with meals, and with broths and soups for a time after having brought forth a progeny. Brood-sows require an ample feeding at all times, as suckling is a heavy demand on the animal, and must be limited to two bearings yearly; three have been tried, but not successfully, as it gives more creation between the issues, as the farrowing is seventeen weeks after impregnation. A very numerous issue is not eligible, the pigs being often puny and delicate; eight and not exceeding ten pigs are the best litter, when the chance is in favour of their being strong and healthy. Sixteen pigs are better from a sow yearly than twenty-four, when deaths will be more frequent, and the living pigs less robust. After weaning, a dry heating food of beans or oats is beneficially given to brood-sows, for the purpose of promoting the desire to breed, which is much forwarded by that application. The pigs gradually learn to eat the food from the trough to prepare for the coarser articles after being weaned.

The next provision is the erection of receiving-sties for the purpose of rearing the young pigs after being weaned or any weaker inferior animals before entering into the close yard, for which an equality, if not a superiority, is required of size and vigour. These apartments are smaller in extent than for large animals, and may be done in inferior workmanship, low in the elevation, but warm in the place of fixture. Litter must be largely supplied, and the food of a fine quality, soups and warm mashes, thickened as the strength and size increase, with a beginning of coarser food in clover and vetches to prepare for the storeyard. An easy passage

is thus provided for the more delicate animals, as the pig has a delicate organism in many points, and sudden and violent changes are adverse to very many breedings of animals. The growth of animals is checked and the general health is disordered by the violent alterations in the internal and external affections, and the pig is sensible beyond most animals of changes of treatment and exposures. On the other hand, its peculiar delicacy adapts the pig to receive the benefit of domesticated habits; its nature is very cosmopolitan, and it is from this quality the most easily of all the animals of the farm weakened, debilitated, and reduced in value by close breeding from near affinities, of which the truth is most striking. But the pig compensates in being the most benefited by cooked food of any fattened beasts, and in being very sensibly alive to kind usage. The domestication is, in fact, very nearly allied to that of poultry.

The next provision of the piggery consists in fattening sties for the prime finished animals that are drawn from the storeyard, as the foremost carcases for going through the finishing process by superior food both in quantity and quality. Their condition must be very forward, more than half fattened, which has been produced and continued from birth upward, so that a comparatively short process is required to reach the last state of fattening. This process from birth upward must be adopted and steadily maintained on the farms now mentioned, as the breeding and fattening go together in the business, and the last is simultaneously produced by the high condition of the first. A starved condition of the young state of existence seldom or never gives a healthy vigour of constitution; the functional organs are never so active after being stunted and paralysed

from want of the proper nutriment at the beginning of life. A forward condition must always be maintained for fattening and the profitable store condition. (See Figs. 21, 22, 23 for plans and elevation of piggeries.)

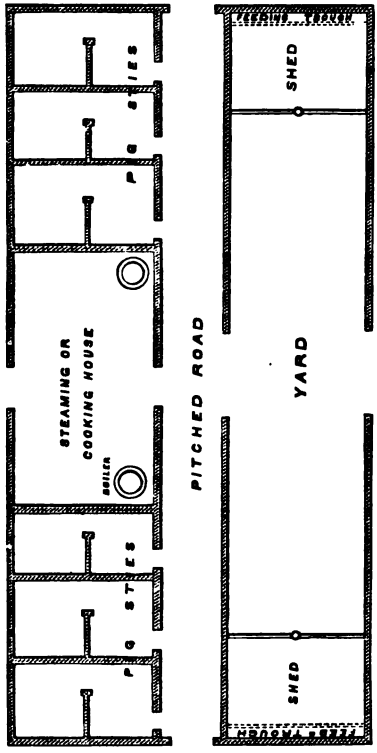


Fig. 21.—Ground Plan of small Piggery. Scale ¼ inch = 10 feet.

In the fattening sties the animals are lodged two together in a double apartment of a covered shed and an open area, in which last the animals take exercise, eat the food from a stone or cast-metal trough, and retire into the covered shed for the purpose of

repose and shelter, &c. The sties are paved with stone floors, covered in roofs of slates or tiles, are low in the elevations for the purpose of warmth, with a declination to throw all moistures to the door of the sty into the conveying gutter along the centre passage into the storeyard as the general recipient of all refuse, vegetable, fecal, or urinary. The utmost possible cleanliness must be maintained by frequent cleanings, and litterings with

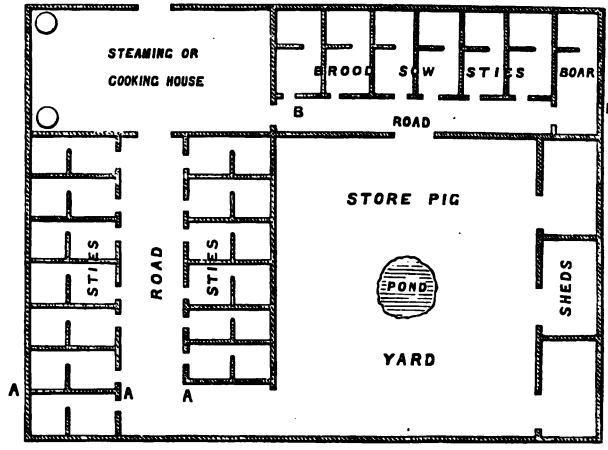


Fig. 22.

short-cut straws, for a pig, though generally reckoned a dirty animal, is seen to observe some notion of cleanliness by very frequently discharging the excrements in one place, and to choose a bed apart from it. The general food consists in steamed potatoes and meals in a half warm mash, brought from the cooking-house along the feeding passages in light iron waggons of four

wheels, and thence discharged by hand shovels into the troughs in the sties through spout holes in the wall. The quantity of food must be in a very full and ample allowance of two meals daily, but not to be left in the trough to become a cold mass of refuse by the animal's choice and disdain. This arrangement is easily made from observation and experience, and must be strictly maintained, and in the half warm condition of the food, without any staleness or acidification. The fresh condition of vegetables is ever to be preferred, or the nearest possible approach to it, without any tendency to decay or possession of acidity. The season of curing bacon will extend over five or six months, and during that time the fattening sties will produce two lots of

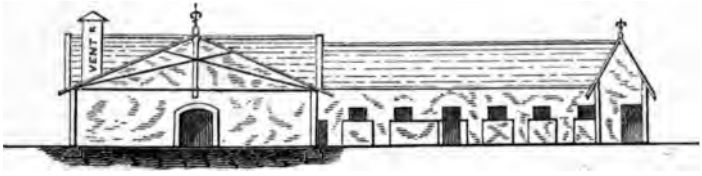


Fig. 23.—Section on line A A A B B in Plan of Piggery in Fig. 22.

prime carcases in succession, proceeding from the forward condition of the storeyard and the full feeding of the sty, with a daily allowance of dry grains during the last month of the fattening process in beans, oats, and barley, and best given in beans, which contain the tannin principle in the pericarp, and tend to bind the muscular frame, assisted by the whitening qualities of barley to secure the delicacy of the flesh in the finished stage of fattening. For whatever may be said on the advantages of grinding and bruising grains for the food of animals, and allowing that the convenience of the preparation confers several advantages

in that mode of use, yet it is seen from observation and experience that much benefit is derived from their being unbruised both in the store and fattening conditions of the animals. The chewing of the grains will produce a quantity of saliva that is most necessary for the digestion of the food, as with the strong grinder teeth of the horse, and in other cases of a less grinding action. And even where entire grains pass through the entrails of the animal in unbroken form, yet the coat of the grains may have been penetrated and the mealy matter moistened by the acting juice of the stomach, and have emitted during the passage through the intestines some exudation or juice that has conveyed a favourable effect on to the sustenance of the organisation. At all events, the fact is certain that dry hard food will produce a condition of body that is more robust and durable than soft and liquid nutriments; the muscular frame is better knit and the flesh is more concentrated and firmer in the texture. This binding tendency is very necessary to all kinds of flesh, and very much to bacon, which is got in many cases from a hasty production of loose flesh and fat, and is subsequently much exposed to handling and carriages. Two qualities are conferred on the animal flesh by the dry grains—a firmness and a delicate whiteness of colour—both much to be desired.

During the vacancy of the curing season, the fattening sties will be occupied in bringing forward the best qualities of fresh porkers chosen from the storeyard from the medium-sized breed, and from the largest bulks of the small breed. In that case the quantity of food may be reduced by one-third below that of the fattening process, as extremely fattened pigs are not recommended for the purpose of fresh pork, but if possible it is well to have a large quantity of sound bean flesh

thoroughly impregnated and inspissated with the juice of fat. This quality is the most desirable in all kinds of animal food, and the object is much defeated by the early precocity of animals from the fineness of breeding, and the over-fattening that is followed at an early age. These two practices have reduced the quality for human food of all animal bodies which are exposed to their action. The sties must be fully occupied; the manufactory of breeding and of fattening admits of no cessation nor any interval of neglect, being one constant stir of production and of reproduction for the never-ceasing purpose of supplying food for the human race.

Another provision of the piggery finds accommodation in small sties for young pigs just removed from being suckled, in order to be fed with delicate food, and to be gradually introduced to the coarser meat of the storeyard. The more delicate in appearance of the pigs are selected for the small sties, to be treated with soups and liquid food, with an occasional taste of the coarser articles to be increased as the relish advances. The bedding must be warm in litter frequently given, and with short straws; the food must be given in a warm condition of gruels and soups thickened with the meal of peas, barley, oats, and beans. The pigs remain under this gentle treatment for a time until brought to be of strength and bulk sufficient to enable them to encounter the rough usage of the storeyard, when the advantage will have been conferred of a gradual and easy passage from suckling the teat for a delicate food to eat the clover and the vetch, and to shell out the raw turnip and the watery potato. Sudden changes are hurtful to all animal and vegetable bodies, and the pig with delicate intestines requires a corresponding treatment with change which should be gradual.

The storeyard is a department of the most primary importance, being the nursery ground of the pigs from the young condition into a higher stage of feeding, and also in being a factory of manure. The articles of pigs and manure are mutually dependent and productive; the pigs depend on the produce of the land for food and maintenance, and the land depends on the manure of the digested food for the production of crops. Pigs produce manure, and manure raises the roots and grains which maintain the pigs. The dependence is so very near and closely fixed that in such a case as the present the notice of one object is wholly imperfect without the treatment of the other, and the special value rests entirely on the relative prosperity of both articles both conjointly and severally, The provision of manure is most essential to uphold the fertility of the soil for the general purposes of production; the cultivator of lands must understand a continued course of amelioration in the use rather than a retrogression in the productive powers of the ground. The latter course will only affect a gradual diminution of business with an approaching fall, and ultimately end in a total ruin. Pigs, roots, and grains are strung together with a mutual attachment so strong, that the failure of one single link in the chain interrupts the progress and reduces the ultimate chances of success. Roots and grains are converted into flesh by the agency of the pig, and manure is produced by the *débris* of the food that is consumed in liquids and in solid excrements, and the manure in return produces the articles of food and litter. Manure is the foundation of every successful cultivation of land, and in the progress of the employment the fertiliser must be applied with a lavish, a constant, and an unsparing

hand. No stop in the acquiring of the article nor in the application must be tolerated.

In a piggery on the largest scale the storeyard occupies the entire width of the ranges of sties that are placed to accommodate the three breeds of pigs that are selected for use in sties of breeding and fattening. The yard reaches forty feet beyond the length of the sties, forming a large roomy space for young store pigs to be raised into a fit condition of age and size for the fattening process. The yard receives all the liquid discharges of the sties in water and urine by a declination of the surface purposely formed; the excrements of the pigs are carried into the yard and spread thinly and evenly over the surface, this being frequently covered with a fresh litter of short-cut straws; all the refuse and fulzie of the establishment are spread over the yard, and all the materials, along with the saponaceous excrement of the pigs, are mixed by the frequent turnings and tossings by the noses of the animals in search of strayed grains and fragments of roots. This mixture is much assisted by the summer soiling of green food, as clovers and vetches, in their remnants of leaves and stems, and by the consuming of raw food in turnips, potatoes, and beet, which always leave an exudation and a fertilising filth. For all these reasons the storeyard must be expressly formed for the special purpose in having a position in a concave basin with a moderate slope from the edge to the centre, with the whole area paved with small-sized stones of a square shape, and placed on an impervious bed of concrete cement. This last provision is essential to any factory of manure, that moisture be present in a large rather than in a scarce abundance; and in order that the presence of it may be equally distributed, the edges of the concave shape of the bottom

of the storeyard are nearly on a level, so that the continued moisture will rise equally in and over the mass of materials that are placed together. This collection is carried to the lands in a fresh condition from the storeyard, and applied without any fermentation; that we find to be an unnecessary process, the fresh state being the most vigorous of acting in all organic bodies. The storeyard must be provided with shelter-sheds in which the animals can repose from rains, storms, and scorching suns. The dry litter of the sheds is frequently removed and spread thinly over the yard, and in every case of using litter attention must be paid to the mixing of dry substances with wet or moist appearances, inferior qualities with the richer substances, in order to procure an equality as much as possible of the fertilising applications, which has great effect in producing a valuable evenness of crops. A shallow pond of water is placed in the yard for the purpose of the pigs wading and drinking and cooling in it, but chiefly to enable the large and heavy pigs to roll and puddle their unwieldy carcases, in which the animals much delight to cool the legs and flanks, and to lave the sides. Water is brought in a pipe, and a tap supplies the necessary amount as it occurs. Taps for the use of water in washing-troughs and passages are placed in several convenient places of the piggery.

The pigs of the best health and strength at the time of weaning are placed in the storeyard, having had a beginning to enable them to eat the coarser food of clover and vetches in the sty of the brood-sow. The weaker pigs are placed in the receiving sties, in which to attain more age and strength from being fed with thickened soups or gruels, and always with a portion of the food of the storeyard to which they may be soon

removed, and may not too deeply feel the change. The inmates of the receiving-sties are changed into the storeyard as soon as a healthy strength is seen to be attained, and the places are filled by a succession from the breeding-sties. The pigs in the storeyard in the breeds of large, medium-sized, and small animals are largely fed during summer months with clovers and vetches, and during winter with turnips, potatoes, and beet, all in the raw condition, the potatoes extending into the new crop of the year. Cabbages may be grown to assist the green meat of the spring months. The treatment in the storeyard must bring the animals into a forward condition, which must be most carefully maintained, so as to produce many choice animals for fresh pork of sorts and sizes from the yard at all times of the year without having been sent to the fattening-sties.

This constantly forwarding condition of animals very much contributes to the mixing of fat and lean flesh, and gives to it a very agreeable taste, and a better condition of both elements; it shortens the time of stall or sty feeding, and consequently gives a quicker passage from the young into the succeeding stages of fattening. The use of the practice shows a very advanced knowledge of the business, besides giving a very considerable profit in the realisation.

Pipes for conveying steam or hot water from the boiler of the cooking-house are wormed underneath the floor of all the sties and also of the shelter-sheds, in order to afford a warmth that is so very beneficial to the prosperity of organic life, and much more to the artificial condition of the fattening carcase. Pigs are very sensible of cold, and shrink beneath the effects of exposure. Hardy in the wilds of the mountain and the

forest, the domesticated condition produces a delicacy that is seldom equalled among the reductions and changes that have been effected in animal life. The application of artificial warmth may not be required in the southern and even in the temperate climates in certain situations of exposure, but over three-fourths of the British Isles its advantages will amply repay the cost, and will be continued with satisfactory remuneration. The use is only required in any situation during the five or six months of winter. The steam, after traversing the whole circuit of pipes, returns condensed into the boiler, or is discharged by a tap into the pond in the storeyard.

A circular piggery (see Figs. 24 and 25) is here exhibited, with which the variety, taste, and fancy that everywhere prevails in all practical undertakings may be pleased. The accommodations and provisions are the same as in the last design; the cooking is done in the centre, with the boilers there placed. The steam rises in pipes to the second floor, into the vats that contain the roots, to be steamed and mixed with meals as food for the fattening hogs. The building rests on the circle outside the inner wall of the foodhouse, and covers the shed and feeding-trough into which the food is pushed down from the second floor, along hollow spouts of tin or zinc, placed to reach from the windows of the second floor to the meat-trough, with the long handle of the spade, shaped to suit the concavity of the spout. This arrangement is very convenient for securing an easy delivery of the food to the pigs, and the advantage is gained of cover alike to the food and to the animal. The sties for boar and brood-sows, young pigs, and fattening hogs, are all provided as has been described, and the storeyard, with its shelter-shed, is large and

capacious for the very important use of the department, with the provision of warming the sties underneath the floor, if preferred, with the fixed taps of water in the necessary places. The whole manufactory of breeding and fattening is placed under cover;

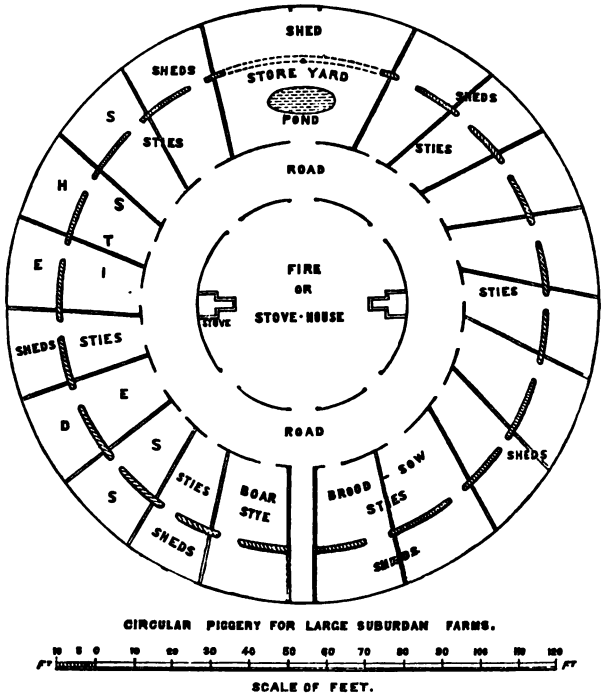


Fig. 24.—Circular Piggery for large Suburban Farms.

the exterior road that runs under the whole outer circumference may be left uncovered at pleasure, by the roofing not extending beyond the outer wall of the sties, or it may reach over the road.

Farms of the largest medium extent and upwards

may be well suited with the design now given, where pigs are used as a part of the livestock of the farm, without any special direction or attention given them beyond any other animal kept for profit. One kind or breed of pigs will be sufficient, and these will have the necessary provisions of cooking-house, breeding and fattening sties, and a storeyard, shelter-shed, and water-pond. The design may be enlarged or reduced to suit any extent of land.

A small design in the plan (in Fig. 21) may suit a farm of the smallest extent, on which swine are kept, in two sows and in rearing the progeny into bacon and fresh pork hogs. The food may be boiled as potatoes and roots, mashed with meals, and these wholly the produce of the land, there being no bought food. The plan can be enlarged or diminished, to suit different extents of land and to meet different opinions.

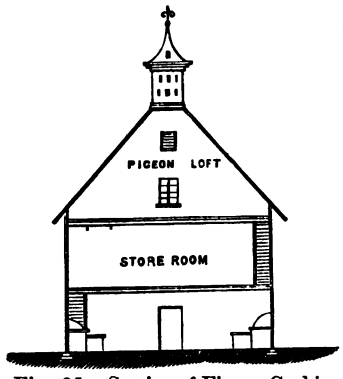


Fig. 25.—Section of Fire or Cooking House in Fig. 24, showing Store-room and Pigeon-loft above.

The three breeds of swine that have been selected for use and described comprehend all the classes that inhabit the British Isles, and every modification of the animals can be easily referred to some one of the kinds before mentioned. The large quantity of the flesh is an inseparable attendant of the animal in a large, medium, or in a small bulk of carcase. No other animal of the farm inherits so very pertinaciously this property, though it belongs in a greater or less degree

to every animal in existence. This invaluable quality must be possessed by all thriving states of farm animal life. An activity is also required, and a disposition to move about in degree less or more, as some exercise promotes a healthy circulation, and assists digestion and assimilation of the food. Though short and fine in the bone, the legs of swine must be sufficiently strong to support the carcase, the head must be small rather than large, but not disproportionately reduced, as in some smaller kinds of animals, the back wide and straight, the skin thick, fine, and gelatinous, coat glossy, with no eruptions on the hide, hair or bristles rather thinly placed on the body, long and fine to the touch, not coarse and harsh, neck short and thick, a great mark of the fattening propensity in all animals, cheeks full, body deep, compact, full, and plump, ears erect, quick, pointed upwards, and not slouching forwards. Width of carcase is the chief essential of a pig, and breadth of loin and breast, a cylindrical squareness of form, with a regular uniformity of size, and an abundant capability of propagation. A refined delicacy reduces the robust properties which constitute a prosperous existence; to combine the conjunction of the two properties is the grand object of all profitable breeding. A too close consanguinity in breeding very soon diminishes the value of the pig, which shows the evil of this in the highest degree sooner than any other improved breed of animals; the size is dwindled and the constitution is enfeebled, the flesh loses quality, the vigour is wanting which upholds the system, and maintains the proper discharge of the natural functions. By employing one male and several female animals the sexual intercourse can be so directed as to obtain three or more removes from the original procreators; the

progeny of the sows and the boar making one remove from the first parents, and the progeny of that remove, still from different sows, forming, by the continuation, another distinct progeny, and so on, till the last breed is without even a recognition of affinity. The fourth remove may, with advantage, be referred back to the original male source, which will continue the blood in the breed to the improvement of animals among themselves, without any introduction of new blood, which, in very many cases, conveys a stain that is eradicated with much difficulty, unless the quality of the new infusion be nearly similar in most points to the stock that is to be engrafted with it. The mode of breeding now recommended by improving animals among themselves is most specially directed to the attention of those who have the farms that are at present the object of consideration, in order to procure and continue a supply of the best flesh in the quantity and quality from the combination of known sources of excellence. A similar combination must be shown in every point of the business—in the cultivation of the land, in the crops of vegetables, in the application of the food, and in the condition of the fattened animals, which form the consummation of the whole undertaking.

Swine are very prolific, the gestation of the female being often considerably advanced before the preceding litter is weaned. But the simultaneous processes of breeding and suckling, or nursing, are too severe to be supported by the animal, and the progeny is best restricted to two litters in the year, which gives some space between the bearings, as the farrowing is in seventeen weeks after impregnation. A very numerous progeny is not desirable, as they are mostly delicate

and puny. Eight, and not exceeding ten, pigs form the best litters, when the chance is of their being strong and healthy. Sixteen pigs from a sow yearly are better than twenty-four, when deaths will become more frequent and the surviving less robust. It is acknowledged, almost without a single doubt being expressed, that swine, before all other animals of the farm, produce the largest quantity of flesh meat from the food that is consumed, and on the smallest bulk of bone, and that the animal eats the greatest variety of food that is the least troublesome in the preparation for use. With the exception of dried forage food—as hays and straws, on which articles alone cattle and sheep are not readily fattened—swine devour promiscuously almost every leaf and root, rejecting little, and consuming very largely. In the store condition of the animals raw food is preferred, as the juice is required to distend the growth. In the fattening process the cooked food is required, in order that the flesh may be easier and more speedily formed. Even in that condition grains are found necessary to impart firmness to the flesh and limbs, and to bind the fibrous texture of the animal frame. The plan is simple, and is daily practised, of rearing and fattening swine in much perfection on unprepared roots and grains, and without any confinement of the animals; and as the process of fattening is slower, the flesh is firmer, and more fixed and concentrated. This mode can be carried out only on a small scale, and with a few of the animals to be bred and fattened; the extensive manufactory of swine demands a separation of the age and purposes of the animals, and the accommodation necessary for the weaning and fattening to be given in separate combinations. Much of the advantages derived from swine arises also from the bulk of excellent

manure that is made by the animals when duly provided with food and litter. No animal of the farm is so useful in this respect, nor does any quadruped void so large a quantity of solid and liquid excrements in proportion to the bulk of carcase. The organs are fitted for quick digestion, which induces a voracious appetite, that is little discriminating, and makes the pig a general devourer of juicy articles and rejected dried forage, as the animal does not ruminate. The variety of food consumed by swine imposes little trouble in its preparation.

No fattened animal is so extensively spread as the pig; the ox and the sheep are only kept on extents of cultivated lands, and by the cultivators themselves, whereas the pig may be kept and reared in any place where there is a human dwelling. The bulk of the animal suits the convenience of any habitation, the food both in quantity and quality is within the reach of almost the poorest inmate, and the unscrupulous taste of the pig is adapted to the little variety of food that can be afforded, and the limited means of procuring extra or bought food. On small farms the use of swine is very extensive, being, in many cases, the chief support of the establishment, especially when near to the demands of towns and naval stations.

The very large consumption of the flesh of swine, as an article of human food, in the fresh and salted condition for domestic use, and in the latter state as an article of exportation and for naval stores, attaches a very great importance to the breeding and management of pigs over the United Kingdom. Every extent of land in fair cultivation to the extent of two hundred acres and upwards, of which a fair portion is capable of producing crops of roots for winter food, can be arranged to constitute a regular manufactory of meat prepared

for sale, and for breeding and fattening the number of animals that can be supported on the extent of ground. Among the animals that are thus entered for the use of the farm, the pig holds a place that is equal to any other of the animals that are bred, reared, and sold. The accommodation that is allotted to swine must be adequate to serve the purposes of rearing, separation, and fattening. The houses are low, to suit the stature of the animal, and the yards are less extensive than those for cattle. The systematic arrangement of managing animals requires that each kind be separately accommodated, and the low bulk of swine demands this removal more than the larger animals of the farm, but which are treated separately. In the general management of swine on all extents of mixed husbandry, the piggery is wholly separated from the farmery, but still adjoining it, and forming a part of the erection. The accommodation universally allotted to swine provides an open yard with a shelter-shed, as for cattle, that being the best contrivance yet known for the intended purpose. Young animals require a freedom of exercise, and a storeyard may be very necessary for young swine, where ten to twenty animals can live in freedom and comfort. A large number creates much molestation one with the other, and prevents the necessary retirement after the fatigue of working with the snout and of consuming the food. In the loose confinement, the animals can be pushed forward into a half-fattened condition, which very much expedites the general business of securing the prime fattened condition.

On dairy farms, where the produce is large of milks and wheys, swine are the indispensable consumers of these articles, which no other animals of the farm are adapted to use. Pigs are consequently very extensively

weaned and fattened under these circumstances. The liquids of the dairy, in the form of a thin mixture with meals, nurse the young pig into small "porkers," and the thicker food of meals and milks fatten the animals, with some raw grains to finish the process. A large quantity of animal food for man is thus produced, and from articles that, but for swine, would be altogether lost and thrown away, which consideration very much raises the value of the pig as a domestic animal, to be reared and fattened. The variety of its food here comes into great prominence.

As yielding a flesh diet for the labouring class of society, swine are much the most useful of all fattened animals, and not only in the cheapness of the flesh, but in the way of its being procured by the poor inhabitant of the cottage. If not a piece of rented ground, at least a garden ground of six or eight hundred square yards should or must be attached to each cottage dwelling on the farm, a quantity of potatoes growing on the farmer's field should form a part of the yearly wages, and a cow should be also kept on the farm on the same condition, and may belong to the labourer or to the farmer as by special arrangement. The vegetable produce of the garden, the potatoes of the field, and the milk of the cow all produce a food for the pig, and in remnants that could not otherwise be used by any other application, but be lost. Accordingly it is essential that every cottage should have an accommodation for a pig, in which the animal can live and be fattened, and under the usual arrangement of two in a year, or three pigs in two years. Two pigs of the medium size in the year will best suit the poor man's purpose. Equal in value with the milk of the cow to the labourer's young family, the flesh of the pig may be a more substantial

diet to the working portion of the people. The offals afford fresh meat, and are made to last for a time; part may be cured, while the hams and bacon afford a ready, wholesome, and substantial food throughout the year. It is this readiness, and the mode of procuring the meat by the home fattening of the pig, that confers the very especial value on the animals for the use of the labouring population. The size of the pig is convenient to the facilities of the cottager; the variety of food eaten by the animal suits the means of maintenance, and the quantity of flesh produced from the food consumed is not equalled by any other animal, and no other flesh-producing quadruped would consume the general food of the pig, which would be altogether lost but for the swine to consume it. The flesh of the pig is almost the only food within the reach of the labouring population, which is, so to say, manufactured at home.

The flesh of the pig, prepared and known as pork, forms a valuable portion of human food, and being salted in a proper condition, it is largely converted into an article for store and export. Pork contains, in 100 parts, 76 of water, albumen 19, other matters 5, ash, &c., 5; 24 parts of nutritive matters being inferior to beef as 24 to 26, to mutton as 24 to 29, and to chicken as 24 to 27. Bacon or dried pork yields in 100 parts flesh-forming matter 8.36, heat-giving matter 55-50, mineral matter or ash 0·50, water 34·72. The quantity of carbon and of heat-giving matters is very large, and the character of the flesh agrees with these results.

The inside fat of the pig, or suet, is much used for culinary purposes, and being melted into lard becomes an article of great demand.

The most eligible size for a fattened pig is 18 to 24 stones (imperial), affording flitches or dried sides of

bacon of 2 or 3 stones, and hams of 12 to 18 lbs. in weight. These weights of parts of the carcase are fitted for any purpose; when small delicacies are required the animals must be bred for the special use of domestic consumption, and in the vicinity of large towns where the choice of meat requires the production of the articles of the particular size and quality.

A pound of green bacon must be worth the tenth part of a bushel of barley, in order that fattening of pigs may be profitable. Then barley at 40*s.* per quarter must yield bacon at 6*d.* per lb.

It is usual to dress pork with the skin unremoved, and the head and feet are generally included in the case, so that the offal of swine consists only of the pluck, entrails, blood, hair, and even these are much less in proportion to the entire weight of the animal in swine than similar offal in any other description of fattened beasts. The difference, therefore, between the live and carcase weight of swine is very much less than that of either oxen or sheep, the proportion of the carcase to the live weight of neither of which exceeds 75 per cent. as the maximum, whereas pork may approach, and in large pigs very frequently reaches, 88 per cent. of the live animal. This range of the proportion of pork in swine suitable for bacon and navy pork has been observed to be between 75 to 88 per cent. of live weight; but in small pork for table the range will probably be only from 70 to 80 per cent.

Brawn is a preparation of swine's flesh made of the adipose membranes, or that which contains the fat, these being rolled up and closely compressed, which squeezes out the oil, leaving the cellular tissue to form a semi-transparent substance, which is a nutritious food for stomachs with strong digestion.

Sucking-pigs are fattened to the age of three weeks with milks and meals, and form a luscious food that is, however, not very digestible.

Pork is cured into bacon by salting, after removing from the carcase the spine attached, and ribs, internal flesh, the kidneys and flesh above, the feet, and head close by the neck behind the ears. The hams are cut out same as mutton, and sometimes all the ribs are removed without leaving the short bones in the middle. The carcase being thus ready for being salted, is rubbed on the skin side with a mixture of salt and saltpetre, fifty parts to one by weight, the incised parts of the ham and the inside of the flitch being covered with same mixture. The bacon in two flitches, with the insides lying on each other, are laid into a pile on inclined benches, with troughs underneath to receive the oozings of brine, which should be rubbed over the meat occasionally. In this state a fortnight cures small flitches below fifteen stones of carcase weight; larger bulks are wiped dry and reversed in the pile with half the first quantity of fresh dry common salt sprinkled over the insides of the cut parts, and these remain another week in the pile. Hams being thicker than flitches will require three or four weeks to remain under the process. Drying is effected by hanging the portions for two or three weeks in a smoke-house, the "curing smoke" being obtained by the combustion of timber, or, if simply dried, heated by stoves. The labourer's pig of two flitches being salted as now directed, is hung up in the cottage and dried. The flitches being rubbed, are laid in a tray which contains the brine, and are frequently turned over before being hung in the room to be dried. This is a very effectual mode, but requires the provision of trays, as on a farm or for a curing establishment;

but for small farms and cottage dwellings a stone bench is the method employed.

Pork loses about fifteen per cent. of weight by the process of curing with salt, which extracts the juices and the water in the meat, thus absorbing the briny solution that has been formed by the union. The astringency of salt contracts the fibres of the muscles and excludes the action of air on the interior substance of the meat. Saltpetre is stronger, and hence the loss of weight by the action of these deleterious bodies, which should only be used in quantity sufficient to preserve the meat. Sugar is now much used, in conjunction with a small portion of salt, for the curing of hams, and it gives, when properly used, a very fine sweet flavour to the meat, infinitely superior to that cured by salt alone. Saltpetre in any method of curing should be used sparingly, as it has a great tendency to harden the fibres of the meat.

Pigs are not troubled with many diseases, which are obscure in the symptoms, and meet with little attention. Rheumatism is frequent from exposure in cold and damp styes. The bowels are then opened with Epsom salts and a dose of colchicum, from two to five grains, for three or four days. "Measles and mange" have affected swine, and are removed by applications as for other animals, in cooling treatment of salts and nitre, and in the latter case with mercurial ointment. "Scrofula" is the result of too fine breeding, and from a weakness of constitution: the natural preventives must be applied. "Quinzy," or swelling in the throat of fat hogs, is relieved by bleeding and purging, and by plácing setons in the punctured swellings. "Catarrh," or cold, is removed by care and warm housing. "Inflammations" of the lungs or chest, of the brain,

and of the bowels do occur—the latter from improper food. The protrusion of the rectum is rather frequent, and fatal with young pigs, and may be produced by violence. The animal must be kept quiet and clean, having no solid food, and only milk. The parts must be washed clean and pushed up some little distance, with the anus secured by a strong thread doubled and knotted. Milk, and no solid food, are given for several days.

The pig on the whole gives little trouble with diseases as with the accommodation of good housing, with the proper kinds and qualities of food, and a constant attention to their comfort and general health, and this quality adds very much to the general value of the animal.

The animal fattened for consumption may be selected at the farmery, the live weight fixed, and the pig conveyed along the same railway with the milk to the same depôts that have been erected for the purpose, and the value is there received. As the swine are comparatively small in bulk, they may be slaughtered in open sheds erected on purpose at the farmery; the dead meat cut into four quarters, with the offals kept apart in separation. Experience has shown that on the best bacon hogs the meat reaches up to eighty per cent. of the live weight, and on smaller bulks the range will be about seventy-five per cent., being four-fifths and three-fourths respectively of the live weights. The large weights may be 25 imperial stones and upwards, and the small weights all that fall below that figure. The dead meat is thus easily arranged from the live weight, and if the price of 6*d.* per lb. for all kinds of pigs is fixed as the constant value to the consumer, a fair distribution will be effected by allowing, along with all the offals, 1*d.* per lb. of dead meat to the butcher on all

weights above 25 imperial stones, and 1½*d.* per lb. on all weights below that figure, leaving 5*d.* and 4½*d.* per lb. to the producer on large and small weights respectively. The animals being slaughtered on the farms will be most convenient, and will banish the absurdity of carrying animals into a town to be slaughtered, producing the very evil of filth and stench that has so long formed a most just complaint. This mode of distribution of the value will render a fair and just share to all parties, and remove the long-standing complaints of high and low prices and their injurious effects.

Fat cows may be treated in the summary by the average of seventy-five per cent. on all weights of dead meat from the live weight, and fixing the general price of 6*d.* per lb. to the consumer, and allowing along with all the offals 1*d.* per lb. on all weights above 50 imperial stones to the butcher, and 1½*d.* per lb. on all weights between that figure which will include the smaller cows and the whole breeds of sheep, leaving 5*d.* and 4½*d.* per lb. to the producer for large and small weights respectively.

Summary of Pig Farming.

The lands must be placed and maintained in the highest possible state of fertility, from an original inferior condition, and from a medium state of fertility, by the primary improvement that has been described, and by the common means of fertilising into the highest possible condition. The management must be wholly self-supporting after the necessary condition has been effected; the crops producing the manure, and manure producing the crops.

The whole and entire aliment of the pigs is produced on the lands in roots, as Swedish turnips, beetroot and potatoes, with cabbages, in herbaceous plants of clover, vetches, and some lucerne, and in ripened crops of barley, beans, and pease. The roots, in a raw or steamed condition, constitute the chief food of the pigs during the winter and summer in the styes and in the store-yard, and are supplied in the most ample allowance that is short of waste. The raw condition, juicy and succulent, best suits the growth of young animals by operating upon the functions of enlargement, and the cooked food supplies the organs of fattening with more condensed substances. The herbaceous growths of clover and vetches supply a greenmeat during the period between the root crops of one year till the produce of next year comes into use. The ripened grains afford meals for soups and hashes, and also uncooked meal or raw grains to the fattening animals in the last stage of the process.

The pigs are bred from several sows and one male, and by using a male and female from different sows a proper degree of distance between the affinities is preserved, which must be in at least three removes from the parent stock. This point must be particularly attended to, as no animal is so easily hurt by the effects of a too close affinity as the pig, thus inducing a tendency to reduce it in size and robust vigour. The eye and the tail give evidence very early of the declining condition, the former being dull and watery, and the latter becoming short and small, wanting in the curly twists, and too far removed in the opposite extreme from the thick and very rope-like form which it possesses in the unimproved condition of the animal.

The brood-sows are best managed when they are

allowed to produce two litters yearly only, and during the period of nursing the young must be amply supplied with juicy food in thick and thin soups of meals made up with water moderately warm. Change of thicker food in meals and mashed roots (steamed) should be given occasionally. All the food is to be given in a warm condition, and not too thin. The pigs must be accustomed to eat the food gradually of the storeyard, to which the strongest ones are removed, and the weaker growths retained in the receiving-sties till they attain the necessary age and strength fitting them to be placed into the storeyard. The ample feeding, with the juicy meat of the storeyard, advances the pigs into the condition of fresh porkers, and the best animals in the sties for bacon hogs, in which two pigs are kept together. The fattening is finished with food of steamed potatoes, mashed with meals of barley and beans, and with a meal daily in the latter end of the process of raw grains, as beans and barley, in order to consolidate and whiten the flesh, and this chiefly by the action of the tannin principle in the bean. This last application is very beneficial. In every place in which the pigs are accommodated, the litter must be most amply supplied in the form of straws cut into short lengths, this condition promoting the comfort of the animals and facilitating the making of the manure.

Hints on the Care and General Management of Pigs and of the Piggery.

The opinion is pretty generally held—both by those directly engaged in farming and those who are not so, or only in the most limited of senses, as pig-keepers, few in number—that of all classes of live stock pigs are those which pay the least, or that they do not pay at all. This opinion or belief, like many others of a similar class, must,

however, be taken with a reservation, for much depends not only upon the class of pigs kept, but also, and perhaps more, upon the way in which they are kept; for a pig of a good class badly kept will pay worse, or be in fact a loss, while another pig of a class not so good, well kept, will pay much better, in fact yield a very fair profit. And this last term brings to mind one reason why pigs do not pay so well as they otherwise might do—we are now referring to cases where they are maintained on a large, or moderately large, scale—the desire to obtain a large profit being such, that the sows are littered far more frequently than they ought. Thus a class of porkers are the result, which from their birth possess but few of the vigorous and healthy characteristics which are alone calculated to bring them on and up to the paying point, and this no matter what the system of feeding adopted may be, however good. The sow, also, is weakened, and thus rendered less valuable as a breeding animal, by the drain made upon her system by the too frequent litterings. As no real profit is gained ultimately by this practice, it should be avoided. The best system is that where the sow yields two litters every year—the best months being those of March and August—as by this arrangement a regular system of keeping up a supply of pigs to be sold off under the different classes of sucking-pigs, young porkers, or to be kept or sold as store pigs, or fed and fattened for the production of pork and bacon, is thus maintained; with the secondary system—primary with some who go in for breeding first-class animals for sale—of producing breeding swine and boars.

Another source of loss, or cause of less profit being made out of pigs than would or might otherwise be the case, is the defective housing, the careless general management, and ill-devised systems of feeding adopted. As regards the first of these points, so wretchedly housed are many pigs, that it is matter of surprise that they contrive to live even through the earlier stages of their existence, so opposed is every detail to what the laws of health demand. And it is not alone in the mere details of construction and arrangement that the evils arise, but from the filthy, slovenly way in which the houses in every department are kept. This latter point—to consider it very briefly first—arises from the popular idea that a pig loves to be dirty. Popular as this

belief is, none can be or is more erroneous, or more conducive to the loss of profit which so many deplore. It should be remembered that the physiological functions, so to say, of a pig are the same as any other animal of the mammalia or sucking tribe; so that the secretions which are so essential to the healthy development of other of our live stock are equally essential to them. These, as for example, in the case of cows and fattening cattle, we have shown in the case of the skin and coat. Now these cannot possibly be deemed healthy if the animal is kept in a condition of dirt, and that of such a character and so persistently that it makes it unpleasant for any one having a love of order and cleanliness. But the best way to find out whether pigs like dirt better than cleanliness, is to try them with the two systems, of dirty—the usual, we regret to say—and the cleanly; there will then be no doubt in the minds of any one not wholly prejudiced in favour of the dirty. It is a delight to see how pigs evidently luxuriate in cleanliness of body and of the litter with which they are supplied. We knew of one eminent pig-feeder, on the large scale, who had a flexible hose-tube for the purpose of washing out not only the pigsties but the bodies of the pigs themselves, and it was a curious and suggestive thing to see how the animals first turned one part, then another part, of their bodies, in order that each might get its fair amount of cleaning, and then to roll and nestle amongst the clean litter afterwards. All this may appear to be taking up space for little purpose; but so far from this, that if what little—and on the subject, in its many aspects, we could say much—we have said will induce any one to adopt the cleanly treatment, who now keeps pigs in the disgracefully dirty way they are usually kept, both as regards bodies and sties, they will find, in the increased profit resulting from the system of cleanliness, enough to prove what we have said to be of great value pecuniarily. We have also stated that physiology proves that pigs are like other of the mammalia in the effects of warmth and cold upon their systems. As in the case of cleanliness of cows and fattening stock, it has been elsewhere shown how, in a singularly beneficial way, warmth acts upon them, so also in the case of pigs. It is as true of them as we have shown it to be of cows, &c., that "meat is heat, and heat meat;" yet how singularly this axiom, in all ordinary feeding, is over-

looked or unknown in the case of pigs may be seen in the great majority of pigsties, even in those of farms otherwise well managed. Litter is given in the most sparing quantity, of the poorest quality, and allowed to remain so long in the yard of the sty exposed to rain and the liquid voidings of the animals, that may be said to lie—as we often have seen them lie—in half liquid mud rather than on litter at all approaching the quality litter ought to possess. Without saying more—and we have by no means exhausted or even alluded to all the points of the subject—let it be accepted as axiomatic that to gain profit, or to have the best chances of gaining profit, out of or by pigs, they must be comfortably and warmly housed and littered, and kept cleanly in their bodies and in all their surroundings.

We now come to the important department of food and feeding. As regards food, in too many instances it is thought, apparently, that any kind of food will do for a pig. While it is perfectly true that pigs will eat all sorts of kitchen refuse, and even garbage of an offensive kind, it is seldom deemed worthy of a moment's thought to consider how much of this omnivorous and rapacious food is owing, first, to the animals very often being stinted in food supplies, and being, therefore, abnormally hungry, they are, in consequence, abnormally omnivorous; and, secondly, whether much of this peculiarity of theirs is not owing to the poor nature of the food—as a feeding substance presenting but a few of the true characteristics of such—given to them, and this even when given abundantly. Certain it is that pigs fed upon food of good quality not only do better in every way, but are not possessed of the voraciousness which, with poor food, is their characteristic. And the reason for this is not far to seek by those who know the scientific and practical principles of food and feeding. How seldom is it that we hear of a system of cropping being adopted specially for the purpose of pig-feeding; and yet such a system will pay, just as every true pig-feeder who knows his business knows that it pays, in finishing off the fattening of a pig, to buy the best quality of oatmeal or other equally good food for the purpose. Let this, then, be taken as another axiomatic principle in pig-feeding, that when adopted on the large scale, or comparatively so, it will pay to have crops specially reared for their food during a certain season of the year. This may

either form the main supply, supplementing it by such other supplies as are generally to be had on a farm, and where there are several people living in the farmhouse; or the converse of this system may be adopted. The first is the best, namely, growing special crops, so that the feeding will be quite independent of sources which may sometimes either fail or afford at times qualities and kinds of food which the pigs will be the better to want than to have. Of course, in addition to farm-grown crops, food in greater or less quantities, and of different kinds, will have to be bought. The farm or home-grown crops are generally green crops, to be cut and grown as forage food. Of these crops a wide variety is at the command of the farmer; and that that may be even more extended than it is, we have shown in a special note devoted to the description of crops which may be added to those usually grown for feeding milk cows, all of which are well adapted for pigs. The crops generally grown or provided for pig-feeding are of the leguminous crops, as beans and pease, and the cereals, as barley and oats; of the root crops, turnips, mangel-wurtzel, beetroot, carrots, parsnips, to which may be added the Jerusalem artichoke—an excellent root for pigs, and of which, when cooked, they are specially fond—and the prickly comfrey, all these being chiefly for winter and early spring feeding, although parsnips, mangel-wurtzel, and artichokes may be fed with all the year round, specially the parsnips, a root which keeps so well that it may be said to be always in season. These will carry the pigs from the beginning of October up to the end of May. Then come in the leaf and green forage crops grown, such as vetches and winter rye, both of course cut green, lucerne, the clovers, rape and white mustard, and a little later on, cabbages—all of which will carry the pigs on from May up till October, beginning the feeding in each year as before named. All these, as already stated, will be supplemented by foods which are to be had from the house and the farm, and the feeding which the stubble fields afford in autumn, together with bought foods, such as, if near a town, brewers' and distillers' refuse, solid, as grains or "draff," and liquid, as wash or "dreg," Indian corn, &c., &c.

With food such as the above, pigs will be supplied with all the substances requisite to feed them, and better than in a way not consistent with the true principles of feeding. But it is not

enough to have good foods; there is a great deal in the way in which they are given to the animals. Generally speaking, the same principles apply to the feeding of pigs which apply to other live stock, the leading ones of which we have elsewhere explained. Of these regularity in feeding, cleanliness of the vessels in which the food is given, are essential points. The point is disputed whether the greater portion of the food should be cooked or raw. No general rule to be adopted in all cases can be given on this point, and this will depend upon the period of the year, warm cooked food being obviously more in season in winter than in summer. And green food in summer will also be more naturally given raw, and be more liked as a rule than cooked, although in winter cabbages, &c., will form a good part of the warm mash. All these points will require on the part of the pig-feeder no small amount of careful consideration; but this being given, difficulties as they occur will be met much more easily, and the results will be much more satisfactory than many might be disposed to admit. Where the dairy is large and the refuse, so to call it, being considerable in amount, the difficulties of feeding, especially where a large proportion of each litter is reserved f r sucking-pigs for town markets, for which there is always a large demand, will be much more easily met.

We now come to give some remarks, as few as brief, on feeding and management in general. And here at the outset we would call attention to a point not seldom overlooked, but which is very important in certain and often frequent circumstances, one especially which concerns the feeder of pigs on the small scale say for domestic purposes. Those who have paid attention to the quality of pork must have observed that that which was slowly fed and fattened possessed a finer quality, greater richness of flavour, cut more firmly under the knife, having a closer and finer grain—always a good sign in meat of all kinds, inferior being coarse and open grained—while the fat was richer, sweeter, and better coloured than pork fed quickly on the forcing system, a system which gives qualities of the opposite character to those named. It would be easy to name the physiological reasons for this difference in results of slow and quick or forcing feeding, did space permit; but this not being at command, we have to content ourselves with the simple statement of the fact, which will open up many suggestive

considerations for feeders of pigs, modifying very materially the way in which they will proceed according to the markets and purposes for which they are designed. Many who have noticed the difference between the qualities of pork could not account for it; they will, from what we have said, be enabled to do so in a general way, and be led, as we hope they will, to follow the subject up and study it in all its bearings, important as they are to the interests of those concerned in the feeding of pigs on the large scale especially; for those who feed for domestic purposes it is enough almost to name the fact.

Taking now the general management of pig-feeding in detail, we begin with the breeding sows. We have already said that, the best months for them to litter in are March or April for the first, &c., and September or October for the second farrow. Breeding sows should not be richly but moderately fed, and not so in any case as to get fat; some fancy that a fat farrow sow will produce finer pigs, but this is a mistake. Some breeders again believe that it is best to keep a farrow sow by herself; it would seem, however, the better plan to let her associate with others in the same condition, as company is good for them. But about a week before her "note," or calculated time of littering, she should be put up in a separate sty, well cleaned, and with clean, sweet straw for littering down, but with not too much of it. Her food should now be such as to promote the secretion of milk, chiefly liquid, but yet fitted to support the system—warm mashes, with occasional cold feeds of dairy stuffs, skim milk, with milk and whey mixed with bran and a proportion of ground oats or oatmeal. The latter must, however, be given but sparingly; it is apt to be overheating and stimulating; indeed it would as a rule be safer to leave the oatmeal out of the list of foods at this time, keeping to those which promote the milk and support her system. Her bowels must be specially attended to, kept gently open, not at all purged; many a valuable animal has been lost or greatly injured by having difficult parturition through want of attention to this point. The management of the farrow sow after delivery involves some points to which care must be given; parturition itself is generally easy in the case of sows, but some have a most unnatural desire to devour their progeny, especially if by some accident or other any of the

pigs should be wounded, even scratched, so that blood is drawn. Again, heavy sows are apt to overlay their pigs and crush or suffocate them to death. The best preventive of this is to have a sloping board at the sides of the sty thus, ◺ under the space of which the young pigs can run, the mother generally lying in this case against the sloping board. This simple contrivance has saved the lives of many a young pig. If the sow devours, or shows a tendency to devour, her progeny, the only plan is to take them from her, and either rear them by means of a foster mother who may be short of her litter, or by hand. The feeding of the sow after is much the same as before delivery, meat being as a rule avoided. Attention should then, as before, be paid to the state of her bowels. Much of the health of the young pigs depends of course upon that of the mother. It is scarcely necessary to say that this is greatly aided by thorough cleanliness of the sty, in the sweetness of the bedding, the sound qualities of the food, the perfect purity of the trough in which it is given, and in the bodily cleanliness of the sow herself.

These points must be attended to in the case of the *young pigs*, to *the general management of which* we now devote a few notices. Weaning is generally done some seven or eight weeks after birth, but they may be got accustomed to the taking of simple foods, such as thin mashes of dairy refuse or bran and whey in water, by having these placed in shallow, low feeding troughs. When they have got accustomed to the weaker food, it may be strengthened by the addition of meals and more nutritious food; if oatmeal be given, more than usual attention must be paid to the state of their bowels. Occasional doses of sulphur will always be found beneficial. In the case of male pigs castration is done about the sixth week; the state of their health must be closely noticed when this operation is gone through. It is often not done at all, but it is essential, as otherwise, for obvious reasons, a strong flavour of a disagreeable kind is given to the meat. As the pigs advance in age, and weaning is got over, the feeding must be abundant and nutritious, and changes both in the kinds of food and the way in which they are given must be an essential part of the system of feeding; regularity in the periods of feeding is a point of no less importance, and if the weather be cold a warm mash at night with another in the morning—but the night mash is essential—should be given.

A small yard, or, better still, a paddock in which they can be allowed to grub at will, should be provided, into which they ought to be turned every day; the warmer the weather the longer the period for this. Should any of the root crops be left, especially the mangel-wurzel, the parsnips, and Jerusalem antichokes, these should form part of their food; and as the finer weather approaches, and green forage food begins to be at command, this should be at once given to them. Of these foods, vetches sown with winter rye is, perhaps, the best, as the vetches seem to act in a peculiarly healthy way upon the young animals; clover also is an excellent green food; and as they come in cabbages should not be overlooked. Of this class of food the variety known as the "Thousand-headed" is particularly valuable. A new plant, elsewhere particularly described in this work, the prickly or Caucasian comfrey, seems to be possessed of many advantages as a food for pigs, and is well worthy of a trial. In feeding, to sum up and conclude, the great point is to keep the animals in a state of regular steady progress. Some will improve quicker and at a more economical rate than others, but still in all the progress must be steady, no "backening" being ever permitted to form part of the system of feeding management.

We have now got the pigs up to that point when they are ready to be set aside either as store pigs or those which are to be at once *fattened, fed off, and sold* as soon as ready for market, and by the plan we have described they will be in the best possible condition for having this done in the quickest time and at the most economical rate. To attempt to fatten a poor pig without such previous management, or one somewhat similar in its general features, as we have above described, will only result in loss—in throwing away, in point of fact, the rich and nutritious food on which it would thus be suddenly put. There must be a preparatory process through which the pig must be put, bringing it from the state of a poor to that of a good pig, with its system in a condition to appropriate and consolidate the rich food provided. Pigs thus prepared must, however, when put up for fattening, be fed with no stinted hand, neither on a system so irregular that one day there will be an over-abundance, so to say, the next a positive lack of supplies. As before stated, the food must be regulative

as well as good. There are "no end of opinions," to quote a phrase often used, as to the methods in which the food decided upon should be given, some, but comparatively few, as to what that food should be. Thus it is a pretty generally held idea that meals are the best food, and of those oats the most nutritious and the most economical in the long run. If the farm is provided with a mill, the oats—which it will pay to grow expressly for feeding purposes—may be most economically prepared by being ground with a roughish mill, the cost being considerably lower than oatmeal bought from the dealer. The meal will be best prepared if made into a thickish kind of gruel or paste, dairy refuse, as whey, butter or skim milk, being better than water. The animals should have at each meal—and three meals a day are the generally allowed number—as much as they can possibly eat, what is left being used for the next meal to follow. Quietness is a necessary element in good paying fattening, and a sure symptom that a pig is fattening properly is his lying down in a quiet state of contentedness after he has taken off his full allowance.

CHAPTER III.

POULTRY.

DOMESTICATED poultry are comprised under four classes —the cock and hen, generally termed therefore as "hens" and often simply as "poultry"—the goose and the turkey. The cock is a native of Northern Asia, and seems to have been very early drawn from the jungle to become the domesticated companion of man. The animal is the "gallus" of ornithology, and the common dunghill cock is the "gallus domesticus," being the tamed variety of the primeval parent of the whole family, which is styled "Phasianus" or pheasant, or the bird of Phasis, a river of Northern Asia, where they are found in great abundance. The common dunghill cock has the comb and wattles compressed, ears naked, tail compressed, erected feathers of the neck linear and long. The cock is a sagacious bird, with manners sedate and composed. His wings are short, and hence he flies seldom, and sometimes his screams indicate the violence of the effort. He claps his wings and crows either in the night or day, but not regularly or at certain hours, and his note differs widely from that of the female. Some domestic hens make a kind of crowing, though fainter, and not so distinctly articulated. The cock scrapes the ground to seek his food, and swallows with the grains little pebbles, which assist digestion. He drinks by taking some little water

into his bill, and raising the head at each draught. He sleeps as a rule on one foot, and his head covered by the wing on the same side.

Zoological classification of the cock:—

Class—Aves, or birds.
Order—Gallinæ, or poultry.
Genus—Gallus, or cock.
Species—Gallus phasianus, or common cock.
Variety—Gallus domesticus, or dunghill cock.

That the cock was introduced in very remote times into Great Britain is evident from the earliest records of the country. Geological research has not been able to fix the period of the existence or appearance of birds in the antediluvian world, or that the race existed in the eras of deposited rocks or above these sedimented masses; it ranks therefore among the creatures of the present zoological period.

Pullus (Latin), a chicken, or young bird; *poule, poulet* (French), *a hen or chicken.* The term "poultry" was originally meant to comprehend the young or the pullets of domestic cocks and hens, which were the first arrivals of that nature that were used by man.

By degrees, the name included the old animals of that kind, and at last was applied, as now, to distinguish all the animals that have been added by domestication to the first use of the cock and hen. Being all applied to the same purpose, the name became to be reckoned appropriate to the animals that could be used in that way, as a comprehensive term, leaving the proper distinction to be made by the special difference.

Under the name of poultry, therefore, are now comprehended all the birds which are used on the farm, which are oviparous, incubate, and hatch the eggs for propagation, and of which the flesh constitutes an

article of food, and consequently of profit in being reared and fattened.

The common cock was the first animal that bore the name of poultry, and was very early taken from the wild condition to partake the advantages of civilisation. The bird is of Eastern origin, and has passed into all the temperate regions of the world by means of conquest and importation. The other classes of poultry have been gradually added by subsequent observation of the use that is attached to the domestication, as confirmed by experience.

The aquatic birds, the duck and the goose, are natives of northern countries, and hence come into use in these regions; the turkey was a native of America, and was soon spread over Europe.

The flesh of the domestic cock and hen is a most tender and delicate article of food, generally agreeable to the palate, and suited to almost every stomach. It makes a favourite broth for invalids, and has ever been esteemed one of the most wholesome and nutritious substances with which the world abounds. Fattened fowls average 7 or 8 lbs. in weight; the flesh contains:—

Water	= ·73
Albumen	= ·20
Gelatin	= ·07
	100

27 parts of nutritive matters. It is the most nutritious of all animal food, next to mutton, and the least stimulant; exceeding beef as 27 to 26, pork as 27 to 24; and inferior to mutton as 27 to 29. Experience supports this value.

The egg of the cock and hen has formed an article of universal use as food, both in ancient and modern

times. It is highly nutritious and substantial, and forms the purest specimen that is known of the substance called "Albumen," and is always quoted when mention is made of that article. The weight of the egg of the ordinary hen is from 785 to 1,000 grains, and when boiled hard weighs 1,060 to 1,070 grains; the albumen 516, and the yolk 273. Specific gravity of new-laid eggs varies from 1·08 to 1·09.

The white of an egg contains:—

Water	= 80·0
Albumen	= 15·5
Uncoagulated matter (mucus)	= 4·5
	100·0

The yolk contains—

Water	= 53·78
Albumen	= 17·47
Yellow oil or fat	= 28·75
	100·00

140 parts of nutritive matter in 1,000 parts. Preserved eggs loose three-quarters of a grain every twenty-four hours by the substitution of air for water, which latter evaporates through the shell-pores. The readiness for, and abundance of, their use constitutes a universal recommendation of the eggs of the domestic fowl as an article of food and profit in the production of national consumption. Females of well-fed poultry will lay eggs nearly all the year round, at least from the early spring into the late autumn, one egg daily being the ordinary produce; sometimes two and three eggs have occurred, but only by accident. Eight or ten hens are allowed to one cock, a larger number produces many addled eggs. The hen incubates over ten

to fifteen sound eggs for about 21 days, and is a kind and faithful nurse of her young. The best breeds are the heavy speckled kind; plump in the body, low on the leg, carrying much flesh, with a deficient fecundity and hardihood. The russet-red breed is higher on the leg and in the body, which is lighter, with a greater fecundity and more hardiness. The wholly black breed lay an abundance of eggs, with less flesh of body and of inferior quality. Many mixed breeds are found, differing in the qualities of use, but which may be easily selected.

Poultry are subject to diseases called pip, roup, fleas, and blindness. The two first are caused by foul water, or by the want of a proper supply of water; the second by a swelling on the rump; others from eating fermenting food and want of fresh air. Good breeding and feeding are the general preventives.

The Duck.

The duck is a member of a very numerous family of swimming birds, of which the classified and distinctive characters are given:—

Class—Aves, or birds.
Order—Anseres.
Genus—Anas.
Species—Anas boschus, or common and tame duck.

The wild duck is an inhabitant of Europe, Asia, and America, preferring the temperate to the tropical climates, and lives chiefly on the water, feeding on fish, plants, frogs, and worms, and almost every kind of offal. The nest is generally formed on the ground; the mother takes little care of the young, and they are frequently polygamous. They pair in the spring, build

their nests among rushes near the water, and lay from ten to sixteen eggs. Sometimes the eggs are laid in the deserted nests of a magpie or crow upon high trees. The unchanging characters of the wild condition are retained by the domesticated duck; the colours are the sport of nature, but the curled feathers of the tail remain in the "drake" (the male bird being so called), and the form of the bill in both sexes. Ducks are very gregarious, and also migatory in the wild condition—in a state of domestication the latter propensity almost wholly disappears. The duck is very sensible of the effects of domestication, and has passed into a wide number of varieties, but all very easily traced to the original type in the wild duck, or grey mallard of naturalists. The animals intermix with each other with much facility.

The duck had been very early used by the northern nations, as the animal abounds in all the temperate regions and northern zones of the globe. The varieties of the duck are exceedingly numerous, but all very easily referred to the original type. The colour of the plumage varies much under domestication, and the different varieties are intermixed. The grey mallard of natural history is the parent of all the domesticated ducks, and that colour appears in almost every variety yet produced, except in the pure white. Breeds having the original colour is reckoned the most handy and the most productive in hatching.

The duck in a domesticated state is an interesting and valuable bird, and its rearing forms an important object in rural economy. The animals are far more intelligent than most kinds of poultry, and from the mode of feeding, which does not involve scratching, they are much less destructive to, if they do not mate-

rially assist, the labours of the husbandman. When kept in a proper situation, with access to pure water, and are fed with proper food, the animals are very profitable, and though the flavour and taste of the flesh is peculiar—oily and indigestible—yet they are far from being unwholesome. Running streams and ponds of clear water are best for their use, though if muddy waters are conveniently placed and abundant they may be used. Ducks are often introduced with a most pleasing effect on the waters of parks and pleasure-grounds, being confined not only to one species, but supplied in many varieties of plumage and form. Little is known of the wild migratory duck, its habits being very retired and silent; and a fuller reliance can scarcely be placed on the accounts of naturalists.

The very interesting family of ducks would require much space for a full description, with the requisite minuteness of detail; but our work requires only a special notice of the common duck.

It is useless to keep ducks without an ample and ready supply of water, to which the access must be easy at all times. The animal is voracious and not fastidious in the choice of food, and requires an ample quantity rather than a high quality of its materials. Steamed potatoes, meals, and grains, are very suitable, and the kinds of food should be restricted, as ducks are foul feeders, and the flesh is found to partake largely of the nature of the food which is consumed. Small gravel and animals are greedily devoured.

The fecundity of the duck is less than that of the hen; the laying of eggs begins in January, when the animal is well fed, and she drops many eggs at random. Five ducks are allowed to one drake, or male. The duck is a bad hatcher, she sits from twenty-eight to

thirty days. The duck is not, as a rule, a good mother, she being fond of water, and often abandons the ducklings to death on the water, and when they are young, helpless, and tender. Hens are most generally used for hatching ducks' eggs, fifteen being a usual number. This, however, is too many. (See Note on Poultry.)

A large dish of water is sunk in the yard, in which the ducklings indulge their natural propensity, and in due time the brood is sent to wander abroad and lodge in the duck-house. The food, during confinement, is in the form of moistened meals, boiled eggs and barley, milk in curds, grits, and seeds of any kind, but soft substances are preferable. Ducks are fattened as will be explained in describing the plans of poultry-houses. The ducks feed in the shelter-sheds, have a separate lodging-house, with an outlet and inlet leading to the pond or stream, and to the yard or small green, or basking-grounds. Young ducks are sooner raised beyond the dangers of rains and colds than fowls, but still care and attention are necessary as in every other department of the farm.

The flesh of the duck is blackish in colour, rather tough, strong-tasted, and thus wanting in delicacy, yet is not unwholesome, but the flesh is much inferior to that of the domestic fowl in every point of quality. The eggs are not much used as food, being strong-tasted and dark in colour, probably from the offal food that is used. It is believed, however, confectioners and pastrycooks reckon that three duck eggs are equal to six of the hen. Although the general value of the duck is among the secondary poultry, it should never be omitted from the farmyard. The animal is very harmless, and causes little disturbance. The average weight of a fattened duck may be stated at 6 lbs.

Geese.

The goose is the congener of the duck, and belongs to the same class and order of natural classification of birds. The goose is the *Anas anser* of ornithology. The bill is large and elevated, of a flesh colour, tinged with yellow, the head and neck cinereous, belly and breast whitish, clouded with grey or ash colour, back grey, the legs of a flesh colour, neck striated. The animal is a general inhabitant of the temperate zones, living in ferns and marshes, breeding there and feeding on seeds, grass, and small insects. In the wildest condition they are migratory, flying in large flocks in a long straight line, or triangular in shape. The colours have varied much by domestication, but the whiteness of the vent always remains, and of the upper tail coverts. White colours have, however, been produced, but which tend backwards to grey, as the original animal is the grey lag of the wild condition. The habit of the goose is gregarious. The nests are placed on the ground near to water, and the broods are numerous. Like to the duck, the migratory propensity is lost by domestication, as the animal seldom flies or makes the attempt.

The goose is a large web-footed animal, aquatic in its habits, floating principally on the waters. The animal feeds more on grass than many others of the family: they never dive, and are formed as much for walking as for swimming. Damp meadows and tufted marshes are the choice resort of geese, especially where there is an abundance of plants.

The common wild, or grey lag goose, is generally understood to be the parent of all the domesticated species of Europe, and is now rarely found in Britain

in the wild condition. Domestication has much increased the size of the animal, and has changed the colour into a white, or nearly so, often speckled with white and grey. The latter colour indicates the more hardy, the former exhibiting the usual delicacy which the white hue gives to all animals. The goose comes originally from the Polar regions, but, migrating southwards, the animal had been observed and was easily domesticated by the nations of the temperate climates.

The male bird, termed the gander, is allowed four females; and when their treatment is good the eggs will be commenced to be dropped by the geese in February and early in March. Watching is necessary to confine the goose to one nest, and after laying about twenty eggs the female is set in a nest in the hatching-house with fifteen good-sized and sound-looking eggs. The goose sits about a month, or twenty-seven to thirty-three days. When hatched the entire brood is carried to a large crib, and confined for a short time, and fed with water, meals, and curdled milk, seeds and grits. The goslings will soon acquire strength to wander abroad and to lodge in the roosting-house. The brood must have an easy access to the running water or to a clear pond, a retirement to a sunny bank of short grass, and a short distance to go to the lodging-house in the poultry yard. The young geese soon grow large on the common food of the yard, and are reckoned a rearing stock.

Two broods of geese are reared in a year, one in the early spring and the other in the beginning of harvest. The latter are called Michaelmas or stubble geese, from their being fattened on the stubble of the harvested grains. This brood comes into use very opportunely, and supplies the early demand of winter and of

Christmas. The geese of this hatch are much superior to those of the spring.

The flesh of the goose is very strong-flavoured, and when fat forms an article of food not very digestible by weak stomachs, but yet it continues to be a favourite dish at certain times of the year. The egg is little relished as food, being strong in taste and unpalatable. A fattened goose weighs about 18 lbs.

The goose is an inactive animal, moves about heavily, and loiters. The demand for farm purposes is not so large as that of the duck, as it requires more food, larger accommodation, and a greater care and attention. The animal is more destructive than the duck, and is in every way a heavier charge to the farmer; it is also more troublesome to the poultry, and requires more separation. Geese are not so very fond of water, and not so voracious in their appetite as the ducks; they are more herbivorous in their feeding, liking green herbs and ripened grains. Hence the great value of open grassy lawns or commons for rearing geese, and of the stubbles of grain crops for the purpose of fattening them. A large and quiet apartment is required for geese, the low stature and small body of the duck requiring less room, and it is managed with a greater ease.

The gander, or male goose, should be wholly of one colour in white or ash grey: the size must be large, the gait active, the eye lively and clear, the voice hoarse and ever ready, and the demeanour very bold and impudent. The goose, or female bird, should be chosen heavy in the body, steady in the deportment, broad on the feet—the latter quality indicating superiority in geese, however curiously inappropriate it may appear. The presence of wide feet is a proof of excel-

lence of a certain kind in all kinds of poultry, only in geese it seems to be more powerful and firmly established.

Turkeys.

The turkey, which may get the name from the proud Turkish strut in the carriage of the body, is a feathered bird of the gallinaceous order, or poultry, and is allowed universally by all authorities to be a native of America, in the temperate and northern parts. It was wholly unknown to the ancients. Before the discovery of the New World there was no such bird in the Old. The first mention of it occurred in 1525, and it inhabited the mainland and the greater islands of the Western World. From Mexico the birds were carried to Spain, and thence to England, so early as 1524, in the reign of Henry VIII. The birds had been rapid and successful, for by the year 1585 our rural feasters enjoyed the flesh of the turkey among other dainties. Tusser writes on the "Five hundred points of good husbandry"—

> "Beefe, mutton and porke, shred pies of the best,
> Pigs, veal, goese, and capon, and 'turkie' well drest,
> Cheese, apples, and nuts,—jolie carols to heare,
> As them in the country, is counted good cheare."

The bird soon became the denizen of every farmyard, and formed a part of the poultry of the housewife. The turkey is classed thus: Class—Aves, or birds. Order—Gallinæ, or poultry. Genus—Meleagris. Species—common turkey.

Generic characters: bill conic, incurvated; head covered with spongy caruncles or fleshy (red coloured) excrescences; chin with a longitudinal, membranous

caruncle; tail broad, expansile; legs of the male spurred. The wild bird lives in woods, and gradually retires from the encroachments of settlers, feeds on nuts, acorns, and insects, and roosts on the highest trees. It is large and unwieldy in the body, and seldom rises on the wing; the wings are moderately long, and not at all formed for supporting so large a bulk in long flights; legs moderately long and very robust; bill convex, short, and strong; eyes small, bright, and piercing; the anterior part of the head strangely covered and ornamented with a pendulous, soft, fleshy substance, as also the sides of the head and throat. The colour is mostly black, and is much varied in domestication. The female has no spurs; the male has a long tuft of black hairs on the breast, struts with an inflated breast, red face, and expanded tail, relaxed frontal cavuncle, makes a singular inward noise, which, when it is uttered audibly, shakes the whole body. The eggs are numerous, white, with reddish or yellowish spots. Turkeys are stupid, quarrelsome, cowardly birds, swift runners, but indifferent fliers, yet delight to perch on very high trees.

The domestication to which the turkey has been so long subjected has very much enlarged the size of the bird from the original condition; the colour has been changed, but not so very much, as with other animals. The colour is the only difference in the tame turkeys, the black bird remaining the most hardy and generally useful. The white are delicate, and the brown, bronze, and copper colours are only distinguished by the plumage and smaller size and the difficulty of being reared; the flesh is delicate from the small bulk of the carcase and the pains taken in their management. No peculiarity is attached to the brown and ash-grey, but

the black are most decidedly superior in every respect—more handy, easily reared, quickly fattened, and the flesh of the best and most concentrated quality. The black is the favourite natural colour, and is produced more abundantly than any other variety of plumage.

The turkey hen is a close sitter, and lays about twenty eggs before the desire of incubation comes on, and that is most generally in the month of March. The period of sitting for hatching the eggs varies from twenty-four to thirty days. The nest should be prepared on the ground floor of the turkey-house, much darkened, and should contain fifteen eggs of approved size and soundness. When all the chicks of the brood are hatched they are removed to a large crib, or placed under a spanned house in a sunny situation during the day, and below a sheet roof during the night. They should be fed with moistened meals, milk curds, crumbled bread, and lastly by dry grains. In two weeks the birds may be allowed the free range of the poultry-yard, roosting overnights in the heated houses (see the designs for poultry accommodation in illustration), and two weeks more must elapse before the young turkeys are exposed to the rains, colds, damps, and atmospheric influences. The young turkey is extremely delicate, and by the want of care at that time the breeder may lose nearly an entire brood. All damage may be wholly prevented by a confinement of the birds as is now directed.

Turkeys are fed on the fare of the poultry-yard, as has been explained; no particular treatment is required beyond giving an ample supply of food, with a warm lodging in a heated apartment. To have a spring brood of turkeys is the best management, for the growing summer heat nurtures and strengthens the bird into a prime condition, while the summer hatchings shrink before

the approaching cold season of autumn, and seldom reach a proper vigour of existence. The average weight of a fattened yearling turkey may be stated at about 20 lbs.

It has been stated that a single service of the male and female turkey suffices to impregnate many eggs, if not for a whole season. This statement is denied, and it may be the safer provision to have a male in constant attendance among the flock. The hen turkey is a good hatcher, a faithful nurse, and an excellent protector of its young. The use of a large expanse of the wings in covering a number of eggs, and of a great warmth of body, are very valuable in hatching eggs of the domestic fowl and in rearing the young, which require much warmth and shelter for some weeks while in an unfledged condition. This protection the expanded wing of the turkey is calculated to afford in an unequalled degree, hatching and rearing as many as thirty chickens. For this purpose alone the turkey is worth its room on the farm, as it hatches common poultry six days sooner than by the hen.

The egg of the turkey is not an acceptable food, being harsh and strongly flavoured. The flesh, however, is tender and nutritious, and continues to hold a high place among the esteemed delicacies of the table.

The four kinds of poultry birds that have been enumerated constitute the fowls of the farm—the cock, duck, goose, and turkey. Other birds may be kept, but if so they will only be for pleasure or fancy.

The aquatic poultry, as ducks and geese, are very useful for their flesh, but fail in the value of the fæces. The quality of the flesh is not, however, acceptable, as it requires a strong digestion; still there is a large demand for each. The peculiar situations which are required

for the rearing and maintenance of these birds increase the cost of keeping them. The domestic fowl is superior to these in many respects, considered commercially. The feathers of ducks and geese are not very valuable, except in the quills from the latter; the feathers of the fowl are used for beds, and are very valuable for this purpose. But a high secondary place must, nevertheless, be allotted to ducks and geese among the poultry of the farm.

The turkey occupies a comparatively low position among poultry, for, though the flesh is highly valued and relished as food, the eggs are rejected, and the feathers are of little worth. Except on extensive farms it seldom is kept, as it requires much food, and a very careful and tender management in the young condition. The accommodation also must be superior in extent, and arrangements made to secure warmth. The amateur use of the turkey is greater than that of farming, as the bird is large and picturesque, and possesses qualities that attract much notice. For the cottage the turkey and the goose are unsuitable, and far below the duck and the fowl in value, the bulk being incommodious, and the food required beyond the supply. But on farms of the medium extent and upwards the turkey should have a place, as adding to the sources of poultry supply, and meeting the wants of all classes of purchasers.

In the vicinity of towns a ready market is found for the flesh and eggs of poultry, as both articles are the delicacies of food, and the birds are systematically reared for the special purpose. In all distant localities the produce of poultry is carried occasionally to market, and at home the eggs and flesh are a ready article of domestic consumption, always acceptable, and most

conveniently useful. The birds live mostly on what they can pick up—offals and insects. When required for a steady demand poultry will be remunerative, paying well for food and attention, as has been detailed, in an equal degree with the other animals of the farm.

The Preservation of Eggs.

From a variety of causes the value of eggs, as an article of commerce, has increased of late years enormously; and this not merely because their consumption has increased, and that amongst classes of the community who years ago rarely used them, scarcely ever had them in their houses, save in times of sickness or convalescence therefrom, and certainly never thought of making them, as they do now, form part of their daily food; but because, and in fact chiefly in consequence of all this, their individual value, so to say, or intrinsic worth has greatly increased also, and prices are now obtained, especially in winter, which would but a few years ago have been deemed fabulous. Seeing, then, the almost fabulous prices which eggs realise—fabulous compared to the prices of the days of our forefathers, not at a period so very remote—it is not to be wondered at that methods have been introduced by which they could be preserved, so that the extra yield of periodical abundance should make up for most of the deficiency of less favourable periods.

The preservation of eggs is no new thing; from motives of economy our grandmothers had a variety of methods, each having her own, which she extolled as the true and the only one by which, while the eggs could be kept, they could be so kept as to maintain all their original delicate flavour; for it is one thing—and comparatively an easy one—to preserve an egg so that its contents should not putrify, it is quite another thing so to preserve it that it shall retain that flavour which makes the article such a delicacy to the healthy, so valuable an aid to the restoration of the weak and the ailing invalid.

The most "ancient," perhaps, of all the methods by which eggs have been preserved, and which is yet carried out to a very large extent in some country houses, is simply rubbing

the surfaces well over with good untainted butter or lard, and then packing them in some dry powdery substance, as bran, or simply laying them on a shelf in a dry place. The theory upon this process is that if you exclude the air from the interior of an egg you preserve it from putrefaction, and that is done by the use of the butter, which closes or "shuts up" the pores by which the air enters through the shell to the interior. It is upon this theory that another method in use in country houses is based, namely, steeping for some time the eggs in a strong solution of lime-water. This is a higher stretch of philosophical experiment, inasmuch as the plan aims at imitating the formation of the material of which the shell is composed, namely, the lime, and making a material which, like it, will fill up the pores of the exterior surface. Another method is to pack the eggs in a mass of common household salt, or, as a modification of this, to keep them floating in a mass of strong salt brine. In all these plans, save the last, the eggs are packed together, yet not so closely as to touch each other; and it is a part of the plan of packing, which must not be neglected, that the eggs shall not be laid on their sides, but "end up;" and it is also an essential feature with those who carry the methods properly out that the small end shall be placed lowest.

So much importance, indeed, do some attach to the mere placing of the eggs separately and in certain positions, that they maintain that they can keep eggs "all the year round," by having a series of shelves provided all over their surface with holes or apertures, and by placing the eggs on these with their smallest ends lowest, the distance between the holes in the shelves being such that the greatest number of eggs can be packed on them without touching each other, this last point being essential, so essential, indeed, that upon it some base another method of preservation, which they maintain is "always successful"—this, by the way, being a feature of all the common or household plans—holding that all that is necessary is to prevent the eggs touching each other, and that this being secured all other good things follow in its train. We have tried all the above-named methods of preservation, and have found them all, with the exception of the last, which has always proved a failure, more or less successful. We say more or less, and this might on consideration be easily understood to be the case.

For in attempting to preserve eggs it must be remembered that we are dealing with materials or objects the nature of which is not of an unvarying or uniform character, and the substances by which they are attempted to be preserved are of themselves varying in character and constituents; there is, moreover, the uncertain element of the atmosphere, which is always varying; and then, again, there is an element which is too often lost sight of, namely, the state of the place in which the eggs and their preserving materials are kept. If this be damp, and in a close confined situation where the air cannot be often renewed, it is just as difficult to keep eggs as it is any other kind of provisions. With a freely ventilated dry larder or cellar we have kept eggs from one season to the other, and the last egg taken out was as fresh and as good apparently as the first; the method we adopted being the first of those we have named, rubbing each egg carefully over with good sweet butter—salt butter is no objection—and then packing them, small end down, in good clean salt, taking care to have each "layer" well and evenly packed down, but not hard pressed, and none of the eggs touching each other.

The extensive and profitable management of poultry requires the two essential provisions of good and suitable feeding with much warmth, the birds in the most valuable kinds being natives of a hot climate, and inherit still a close attachment to a benign atmosphere. It was observed by the Roman writers on rural affairs that poultry enjoyed their existence most agreeably among smoke and warmth, and the fact is very fully corroborated by the poultry of labourers producing the greatest abundance of eggs, from roosting in the warmth of the cottage, and the cotter's cabin in Ireland exhibiting the most numerous and the healthiest broods of poultry where they occupy the same place as the pig.

This fact needs no further demonstration, and has always been recorded by writers on poultry.

In order to afford the necessary warmth in the cold

and variable climate of the British Isles, an artificial provision must be made, by which a regular supply of heat is procured for the comfort of the animals, and at the same time duly availing of the natural advantages of the situation, which will assist in the attainment of the object in view. In the poultry-yards here delineated the houses form three sides of a square, with the south front open, unless confined by a railing of upright timber stakes. A fine house for cooking the food by boiling or steaming potatoes, mashed with meals, occupies the centre of the back range of the buildings, and from it pipes convey hot water to spaces beneath the floors of the roosting and hatching houses, and are so placed as to warm every corner in an equable degree. This provision of a warm floor will give much comfort to the poultry when the shelter of the house is required during storms and rain, and also for the day and night. The roosting-houses are provided with round poles on which the animals perch with the claws of the feet encircling the timber, better than when only a part of the pole is embraced by them. The roosting-timbers are arranged pyramidally, which affords low sittings for the young poultry that are unable to mount higher, and it also clears the lower seats from the excrements discharged from above, as in ascending to an apex each step converges from the outer, and leaves it uppermost in its position, an arrangement which keeps the birds clean and undefiled. The hatching-houses are provided with nests placed in tiers all round the walls, but most convenient in covered rows on the ground, and filled either with chaff or short straws, dry sands, and moss. When the broods are fully hatched, the young are carried with the mother to the cribs in a yard and shed, which are shut by night and open by

day with a door of slip board, affording air and exercise with the proper shelter. In this confinement the broods remain till full-feathered and grown strong to bear colds and rains, and to roost in the house of common resort. This arrangement will prevent the losses that are sustained by the sudden removal of the young chickens from the hatching-house to the exposure of colds and rains before the animals are able to bear the change, for when the floor of the roosting-house is open for the use of the young broods, much confusion and losses ensue from the mixture of different kinds, which losses will be prevented by the separate confinement of the cribs, which will well repay the small cost of their erection.

Geese and ducks, being aquatic birds, are inured to colds, and may not require the lodging-houses to be so much heated; but the floor is boarded and may be gently heated, as even aquatic birds are seen to select warm knolls of ground on which to squat. The nests are on the ground around the wall, whence the young broods are removed into the cribs for a time, as with fowls; or, as the bird is more hardy, and the broods may not be so numerous, the young broods may be risked in the lodging-house, as they soon grow beyond the reach of danger. A pond of water in the centre of the yard will afford the natural delight of swimming to the ducks and geese.

Open sheds are provided, in which the poultry of every kind are assembled to avoid extreme heats and storms of wind and rain, and also to eat the grain food strewed on the ground, and mashed potatoes and meals placed in the troughs. A shed will thus afford a most agreeable and useful resort to all poultry, young and old.

The fence of the south front may be closely spanned,

and ten or twelve feet high, in order to prevent theft or any passing out of the birds. The gate is the usual width, closely sparred, and in it are passage holes for the different birds, and which can be opened and shut, as occasion may require. The interior area of the yard is strewed with gravel, chalk, sand, rough earths, and small pebbles. The bruised mortar of old houses affords a good scattering material to be picked up by the animals.

A level or sloping sward of green grass should stretch, or must be formed, from the front of the poultry yard to a stream of running water, into which an easy descent leads the young ducks and geese. The dry bank of short grass will afford a squatting and basking ground to the birds when tired of the water. It seems a favourite employment for them to squat on the dry and level sward, and bask in the rays of the sun. A cart-road of gravel may very appropriately pass along the front of the yard, between it and the open ground of grassy lawn.

The cooking of food will procced during the whole year, but chiefly during the winter months, from November to March inclusive. Potatoes will form the principal article to be boiled or steamed, with an occasional mixture of turnips, carrots, parsnips, and beetroot; but potatoes will answer the same purpose alone.

Cooling-vats are provided in the steaming-house, for the purpose of mashing and mixing the steamed roots with the meals of barley, oats, and beans; wooden troughs are placed in the shelter-sheds, in which the food is placed twice a day to be eaten by all the poultry at pleasure. At the same time, the dry food, in the form of grains of oats and barley, is strewed on the ground in front of the sheds and in the houses under

cover. The wide shovel bills of the ducks and geese can get the thickened food from the troughs, while the narrow bills of turkeys and fowls pick the single grains from the earth. Food must be given in abundance, but not to be destroyed from not being used. Fowls are shy of all wet, and the mixture must be in a dry and mealy state rather than moist, in order that the natural relish of the birds may be indulged. A thin watery food is very unfit for poultry, and is not relished either by geese or ducks, which delight in water. A warmish condition must also be given to the food.

The heating of the houses will be required in the northern parts of the kingdom from September to May, as the climate is cold, and the tempests severe. In the southern parts of the kingdom the climate is much milder, which will shorten the period of artificial warming by three months. In these localities the houses may be built with timber posts and feather-edged boards on the outside, and plain boards on the inside; the interval between the boards being filled with straw or some similar substance will add much to the warmth of the house. The roofs may be laid with feather-edged boards, which may be rendered very durable by a smearing of pitch or coal tar. Timber houses are objected to as being combustible, and bricks are more substantial as well as free from this objection to a great extent.

In the arrangement now described, the breeding of poultry may go on throughout the year, with the expectation of the chickens being weaker and more delicate during the winter. If the hatching be intermitted in the months of October, November, and December, it may be very advantageously commenced in January, so that the young broods may appear early in February

—the days are lengthening, and the sun increases in power—and after that time the breeding of all kinds of poultry may be continued unremittingly. Geese and turkeys are not capable of being bred in such abundance as the common fowl, the time of incubation being longer, and the animals requiring a longer period for reaching maturity. Two broods in the season, or at most three sittings, are sufficient to fill up the requisite time. Fowls well fed in the manner now described, and having the advantage of warmth in the heated houses, will lay eggs almost throughout the whole year, and the same advantages will promote hatching and rearing of chickens during the same time.

Well-fed poultry should lay eggs nearly all the year round; at least, they will very quickly begin as the days are lengthened after the winter solstice. One egg daily is the ordinary produce of the hen; some are mentioned as producing two, and Aristotle has named hens laying as many as three. Eight to ten hens are allowed to one cock; a larger number produces many addled eggs. So soon as the desire of incubation is decisively apparent, the hen must be set in a box in the hatching-house over ten to fifteen good-sized fresh eggs, where the sitting should be wholly unmolested for twenty-one to twenty-four days. Food and water must be placed in the hatching-house, so that the brood-hens do not spend any time in seeking the necessary sustenance. The setting afterwards may be continued in any number, as may be wished. When any brood of eggs is fairly hatched, generally in twenty-one days, the whole number of the chickens, along with the mother hen, are removed to one of the small cribs that are seen in the plan in front of the houses, and which are formed as a house with yard and pro-

vided with boarded floors, and may be heated in the early months of the year underneath by a pipe leading from the main conductor, connected with the fire-place of the cooking-house, as has been shown and described.

The building accommodation on a pig and poultry farm is comprised in a house on the ground floor and in the elevation, and the necessary small offices, with the pig and poultry yard joined in the position of a very convenient arrangement, as the same fire-house supplies both departments with cooked food. In this way the hatching and roosting houses are heated by pipes from the fire-place, and the cooked food is brought into the poultry-yard along a road of flag-stones in a light iron waggon. The interior arrangement of both yards is the same, as has been shown in the single plans. The design here described is very compact and suited to the purpose, and will be well adapted for farms which have a less quantity of land than those requiring the largest plans of accommodation. In such building arrangements the size and number of apartments will vary much. No exact rule can be maintained in designing every part, so that different circumstances must be provided and allowed for. A design suitable for the largest quantity of land will be found in the plan of accommodation that is here shown (see Fig. 26, page 228). The dwelling-house may form part of a general design (see Figs. 34 and 35 for plans; the elevation may be in one or other of the styles elsewhere given).

The preceding arrangements of the accommodation for poultry for breeding, rearing, and fattening are designed in accordance with the practice of allowing all kinds of poultry to mix together. Experience has shown that poultry do not thrive in a mixed assemblage.

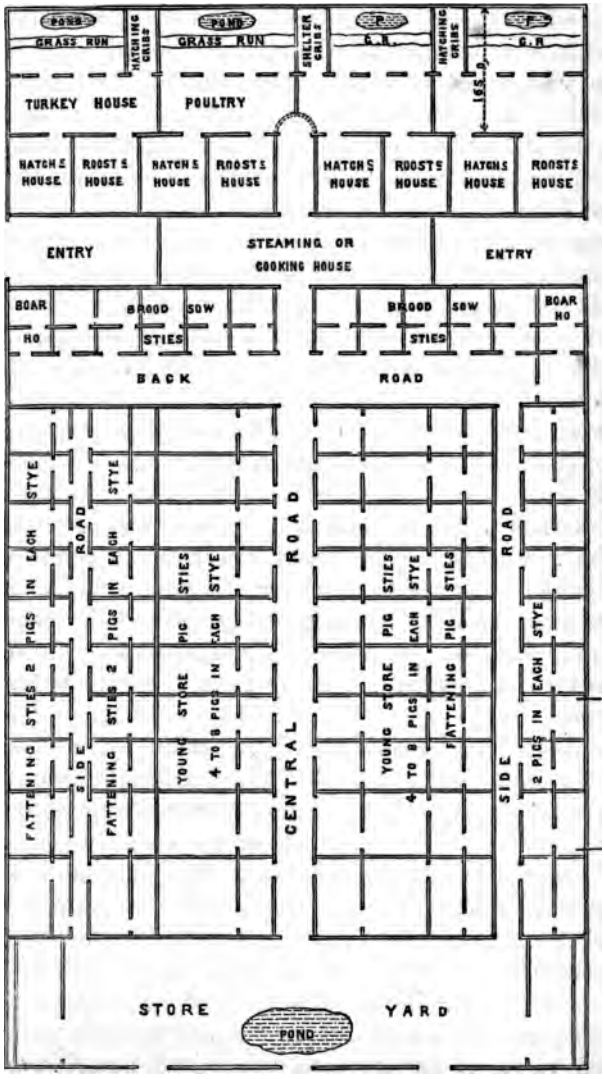
In a large number of breeds, different in tastes and habits, this prevents their agreement; they are like to most domesticated animals in preferring the rest and comforts of separation and repose to exertion and fatigue, for the development of the functional organs and muscular frame, and this chiefly for the special purpose of being converted into a vehicle of flesh and fat for human consumption. In order that the farms that are now intended for special purpose may possess every advantage that can be devised to further and advance the object in view, it is proposed that each kind of poultry live in a complete separation on the ground and lodging, and that every possible encouragement be afforded to the different tastes and habits. The special poultry-yard and piggery will each form a parallelogram or oblong square, the sides being twice the length of the ends, which forms the figure in the plan in Fig. 26.

The end of the poultry-yard, in a cross-wall of 60 yards in length, is divided into four parts of 15 yards, with a length of 120 yards, giving to each kind of animals an open ground of 1,800 square yards, something more than one-third of an acre, the whole area of the erection being an acre and a half. The width of 15 yards is divided into four apartments for hatching and roosting, the front walls being 8 or 9 feet high, and the back wall 14 feet in height, the houses, forming a "lean-to," having a width of floor of 12 feet. The floors are to be all boarded, and warmed underneath by pipes from the cooking-house. The houses are provided with nests for hatching, pyramidal tiers of poles for roosting, and movable cribs of spars for the temporary confinement of broods and single birds. The walls separating the parts of the yard are 8 feet high, and along the sides, as lean-to's, sheds and small houses are erected

into which the animals retire to avoid suns and storms, and to be refreshed after the fatigue of wandering over the yard, which is kept with a close and short grassy surface, with some spots or spaces of small pebbles, earthy and chalky gravels, with any pounded mortars or fragmented ruins of old buildings. The domestic fowl is much amused with, if it be not the better for, these earthy and limy fragments. Pure water must be placed in a trough and very frequently renewed.

It will be very beneficial if the ground of the ducks and geese communicates with a running stream, in order that the animals may enjoy their favourite employment of swimming and searching for food. If a stream is not already existing, or cannot be procured, two or three ponds of water must be made for the ducks and geese, and supplied with water from the pump of the farmery. The bottoms of the ponds must be closely cemented to hold the water. Very small ponds or basins of water are required for the young ducklings, free from the disturbances of the general pond. Geese require the same provisions. Dry sunny banks for the birds basking upon are easily formed on the water's edge.

The cooking-house is placed longitudinally, as shown in the centre of the lengths of the erections, outside the walls, and occupying a length of 80 feet, leaving a distance of 50 feet from each end of the extreme corners of the piggery and poultry-yard. The building has a second floor on which to store the dry food, as grains, and as may be wanted for use these are passed by shoots down to the ground floor, on which the cooked food is prepared by steaming. The roots of esculent plants, chiefly potatoes, are mashed and mixed in cooling-vats, with meals of barley, oats, pease, and beans, into a



SCALE OF FEET.

Fig. 26.—Plan of general Farmery for Pigs and Poultry.

moist consistence for pigs and the aquatic poultry, and in a drier or more mealy condition for the domestic fowls. The central position of the cooking-house in both directions supplies the prepared food to pigs and poultry, and is carried on a light iron waggon along a stone pavement, and placed in troughs twice daily in the poultry-yard in front of the lodging-houses. These are placed below a light roof supported on pillars, to shelter the animals and preserve the food in the lukewarm condition which is essentially necessary in all modes of supplying the food. For the picking of grains from the ground, the fowls prefer an earthy floor to a clean stone pavement. The ends of the cooking-house have an approach of 20 feet, the full width of the house, and which receives the roots at one end door, and the dry grains at the other end on the second floor, and which are hoisted up to it by a rope and pulley. The house receives the various materials by the end doors, and discharges the prepared food by the side doors.

The separate yards and apartments that are prepared for each different kind of poultry will be attended with many advantages in the conditions of rearing and fattening. The young birds are secured from disturbances in a warm hatching-house, and in movable cribs in any part of the yards, and in shelter-sheds that are very amply provided. In front of the shelter-sheds, separate compartments may be formed for special purposes by hurdle fences, which may be very useful in forwarding any particular object in view. The yard is large, to indulge the wandering habits of the birds. Every department must be kept very clean and amply supplied with fresh water; food must be abundant, but not wasted; a large exposure of fresh air, with a warm

aspect, provided. All these advantages cannot fail to contribute to the success of the work which is carried out in all the various departments of the Farm.

The General Management of Poultry.

The author in the text, having confined his brief remarks on the important subject of poultry to the breeds fitted for the special farms described, we deem it necessary to add to these others taking up the subject of their general management. The practical utility of these will be obvious in considering the important position which the author has given in his work to what may be called, from the extensive scale in which it is carried out, "poultry farming," for the supply of towns, with the various forms of its produce.

In the plans of the buildings adapted to the poultry farms, our author has confined himself chiefly to "arrangement," showing how the various compartments suited for the different classes of birds may be most conveniently arranged, so as to form at one and the same time a series of apartments capable of being worked or attended to with the least expenditure of time and labour; and yet to form a harmonious whole, taking up the least possible space of ground. While such was the aim of the author, how far he succeeded in realising it his plans must speak for themselves. He did not consider it as forming part of the scheme of his work to give the details of arrangement and construction of the different apartments which made up the various plans. These, however, it has been deemed advisable to give, for practical reasons, such as we have now to present to the reader.

Although for each class of birds there are certain rules of management which may be termed special, from the definite purpose which the birds belonging to it have to fulfil, and which in course will be duly taken note of, there are general rules which are applicable to all of the classes of poultry selected for the purposes we shall name, and which rules must be attended to if the best and most economical results are desired, as desired by every one they are, although the necessary labour to secure them is often grudged, and too often greatly withheld.

The first point to be attended to is the *housing or shelter of the poultry*. The slightest examination of the habits of the birds and of the peculiarities of their original habitat and its climate will suffice to show that this department is of great importance, and that upon the way in which it is organized and kept up depends greatly the success of the poultry-keeper. Coming or brought from a warm climate, and retaining, to a degree that is, perhaps, more remarkably decided than in any other class of our "domesticated live stock," their habits of living and their bodily or physical characteristics, the first feature which presents itself to our notice is their love of warmth. No one who has the habit of observing things which come up before him can have failed, if at all connected with poultry, to have noticed how strongly this habit of body is developed in them all, there being no exception to the rule amongst all the breeds we rear; although of course there are degrees in this, some being more hardy, and therefore better able to stand cold and withstand the prejudicial effects which it has upon their constitution, and in retarding their fattening, if being fattened, or their laying, if kept for this purpose.

It is essential, therefore, that the house in which the birds are kept should not be so ill constructed that they shall be subjected to biting cold winds blowing in upon them as they roost, through its cracks and crannies and defectively fitting doors or windows, if it be provided with them. And yet, strange to say, this is too often the kind of structure in which poultry are condemned to pass the cold and trying months yet before the poultry-keeper, notwithstanding all the results of observation and experience; yet, stranger still to say, their owners wonder why the birds will neither fatten nor lay, and blame them for this fault with the other, while in truth the faults are all their own, and the blame lies at their own door. But while a poultry-house should be warm and well sheltered from the worst of all winds, the east (and north-east little if any better), which ever seems to bear with it the seeds of discomfort and disease to nearly all living things, it should not be constructed so as to be close and confined, "bottling up," as some one has phrased it, the poor birds in an atmosphere which is sure to bring about some complaint or disease among them. How to ventilate a poultry-house is not our duty at present to explain, but

ventilated it must be, and it will be so only if fresh or pure air be supplied as well as the foul or impure be withdrawn; these two points must be equally well attended to, or no ventilation will be secured. So fond are poultry of warmth, and such are its beneficial effects if judiciously secured to them upon all their functions during the winter months, that some, indeed many, authorities maintain that all poultry-houses should be artificially warmed. It will be observed that in the body of the work, where plans of poultry-houses are given, arrangements are described by which these are to be kept at a uniform temperature throughout the winter by special methods of warming. In small poultry-houses a stove may be used, or even a common fire-place, should that happen to be in the apartment fitted up for the poultry. It is amusing to observe the stratagems employed by the birds to get a roosting-place the nearest possible to the source of heat; not quite so amusing, rather humiliating, as forming a grotesque caricature upon some of our own doings in life, to notice the way in which the stronger birds shove off the weaker ones, who generally go to roost first to gain the coveted place and secure it for themselves. In whatever way warmed and by whatever method, two points should be attended to: the equable distribution of heat throughout the building, and the avoidance of anything like closeness and stuffiness of the air. One great advantage obtained by warming the house is, that it will free it from damp; and to which end it will be advisable to commence warming the house rather early in the season, and with a low temperature, gradually raising it as the cold increases, and specially during damp, muggy, "drear November" weather, which, perhaps, has as bad an effect upon the birds—we believe indeed that it has—as even severe cold.

An essential part of the fittings of the poultry-house is the "dust-bath," if such a simple affair as a mere hole in the dry soil, so dry as to be easily formed into dust, can be called a fitting. But such as it is, it cannot possibly be dispensed with. Fowls soon make dust baths of their own when out in their runs or in the road or street; but the house dust-bath must be under cover, so that in rainy or snowy weather it shall not be exposed to the risk of becoming a mud bath. There is nothing apparently gives a fowl greater pleasure than having a dust-bath, and it is worth

while for any who are fond of the "doings of the living things in our charge and entrusted to our cares," to watch now and then what those of fowls are when in the bath. Of course it is only those of us who are wholly ignorant of poultry who require to be informed that fowls like dust-baths in order to get rid of the vermin with which they are so often and so cruelly tormented; the dust which they so industriously and cleverly work in to the very roots of their feathers seeming to have the effect either of mechanically dislodging the parasites—"black spirits and grey" are they—or of killing them. A good deal has been written on the subject of dust-baths as to which is the best material to fill it with when the hole is made under cover; some maintaining that coal and wood ashes are the best—of these the wood having the preference with some; others that sand is better than either—that is, river or land, not sea sand, which latter is never really dry, and in damp weather is actually moist; and some again holding that the dust of the soil, and specially road dust, is the best of all. So far as we have seen we incline to think that, if allowed the choice, fowls would give soil or road dust the preference. In some cases fowls are so dreadfully infested with the vermin, that what with their attacks and the scratching efforts made by the fowls to get rid of them, parts of their bodies get into sores, others highly inflamed. A capital ointment to mollify the former is sulphur and lard, and to reduce the latter a sprinkling of the dry sulphur as close to the roots of the feathers as possible. The latter application, indeed, is a good thing for the vermin —or rather a bad thing for them.

In addition to the supply of dust to the fowls, there should be also that of lime or of broken egg-shells. That fowls will peck often, and apparently with great relish, at pieces of old mortar or at egg-shells, is clear enough to any observer; but whether it is for the purpose of laying up a store of lime particles in their interiors to be drawn as needs serve for the functions of the shells of the eggs they themselves lay, or whether such lime can really be taken up to form or aid in forming the material of egg-shells, is a disputed point. Disputed it is, however, more by some men of science, or who assume to be such, than by poultry-keepers, of whom it may be said that generally they are firm believers in the old-established opinion, that unless

fowls are supplied regularly with lime in one form or another—generally, as we stated, as old mortar from walls or broken egg-shells—the eggs they lay will either have shells very thin and easily broken or be without shells at all. As to which of the two opinions is the correct one we do not here pretend to say; further than this we do not go, that seeing the lime they thus swallow is insoluble, there is just a "little" difficulty in understanding how it is taken up by the system and again given out (along with the other substances which form the egg-meat, so to call it) from the egg-shell. But the body of a living thing is a queer chemical laboratory, and it is difficult to say what singular changes go on within it. Enough, perhaps, for the poultry-keeper it is to know, that as the fowls do eat old mortar, lime, or egg-shells, and seem to relish it, and as they know best why they do so, it will be the safest and surest plan to give them a supply. Those who do not go to the expense of providing the poultry-house with means of uniformly warming it, still, believing in the advantage of keeping up the animal heat in the birds, not only give them *judicious supplies of sound food*—a most important point, cheap food not being worth paying for at all—but add to it some warming condimental substances, such as cayenne pepper or the like. Some breeders object to these condiments; but we believe that when judiciously selected and administered they have a beneficial effect upon the poultry. Others, again, content themselves with giving the birds their food in a warm state, this being especially the case with their first or morning meal. If the weather be cold or damp, and the poultry house not warmed, the same, we think, ought to be given at night. The addition of a little oatmeal food with their usual feeding substances will be found decidedly beneficial, and promotive of laying during the cold winter months. They are specially fond of liver; this ought to be cooked, however. Poultry will rarely touch it—at least, will rarely eat it—if given raw, which some do; arguing that as they eat the worms they pick up in an uncooked condition, they should have other animal food in the same state. But it is too often forgotten, in considering the subject of feeding of live stock of all kinds, that they in common with us have their peculiar tastes, their likes and dislikes, and that so far as the above argument is concerned it cuts two ways, for just

as we eat frequently—some holding that it is the true way to do so—oysters raw, it would scarcely do to say that we must have our liver and bacon or other dishes raw also. While good sound food is essential to the health of poultry, with them, as with other farm stock, changes in the kind and also in *the way in which it is prepared* are specially beneficial. It is a great mistake to keep feeding stock of any kind always upon the same kind of food, and given or prepared in the same way. A change of food gives a zest to it, and acts, moreover, beneficially in a physiological way. What may be called a "stock food" for the cold autumn and spring days, and specially for winter weather, forming their food almost every day, is very soft boiled potatoes mixed with sharps, or the coarse refuse of flour-dressing machines, as they are in many districts called. In place of water, if the weak stock in which meat has been boiled, or good kitchen liquid—not dirty dish-water, which some think quite good enough—be used to mix the potatoes and sharps, the food will be all the better. Bread-crust soaked till quite soft may be also used; care being taken not to use the best crusts, which ought to go to the family puddings. In brief, a good deal of kitchen and larder stuff, which too frequently is thrown away, may be used with profit for the poultry, always remembering that they will not thrive upon dirty stuff. "Master piggy," not being so scrupulous in the matter of food, may get this, although we confess to having a notion that unclean food is not good for even this "unclean animal." The food thus prepared should be given warm, and one point is essential to be remembered in this and in any other made up or mixed food, that it be not sticky or glutinous, but so that it will easily crumble. Sharps have the advantage of giving this friability to the food, which some other substances do not possess; thus, barley-meal is apt to be cloggy, as also flour of an inferior quality, sometimes used when it can be had very cheap. The importance of having a "short" food, as it may be called, for poultry may be easily seen if one will watch for a time the way in which they are annoyed by having adhesive food. When liver is given it should be boiled hard till it crumbles. This food should in winter form part of at least one meal a day—if its place be not supplied with animal food, in some form or another, from the

kitchen—for their supplies of "cold meat" found in the fields in genial weather, in the form of worms and insects, are largely cut off in winter. We need say little as to the importance of having and giving to the birds *ample supplies of the best and purest water which can be obtained.* It is pitiable to see the filthy, disgusting liquid so often given to the poor birds to drink. The vessels with some are rarely ever cleaned out, which neglect is simply unpardonable. In hard frosty weather let it be remembered that water will freeze; we have not seldom seen fowls pecking away at the frozen surfaces of their drinking-vessels, and looking astonished—do not let the unobservant reader suppose that even hens lack expression in their physiognomy—at the unusual result; a dilemma which has its comical side, were it not in a thinking mind overridden by its humane one. The condition of the drinking-vessels should therefore be looked to during frosty weather, and of course specially so in the mornings. Opinions are divided *as to the number of "set meals" which poultry ought to have daily in winter time*; some only give two, the morning and evening one, omitting what others give, the third or mid-day one. Hard and fast rules no more do in the poultry-yard than in any other department of the farm. Should the weather be open and mild—which it often is, even in the depth of winter—the set meals may be lessened, as then the birds can go out on the grass run, and the same weather which tempts them out tempts also *some* of the forms of insect life, &c., to come out also, and afford food for the birds, which will make up somewhat for the omitted meal—"somewhat," for although externally the weather may be mild and open, after a run of hard frost it does not follow that the ground will be open also. In brief, the poultry-keeper must keep his, or her, "weather-eye open," as the sailors say, and judge accordingly; for whilst the birds ought not to be over-fed—in which case, getting over-fat, they will cease to lay, if under favourable circumstances they will be laying—still they should not be under-fed. A mid-day meal, if not a full one, will keep them going; and the evening meal ought to be solid and good, to enable the birds to get through the long cold winter night with comfort from the bodily caloric the food will supply. A handful of Indian corn or oats will be found a capital thing to keep up the "kitchen fire," as some one has graphically termed the

bodily system. It will be advisable to have a small plot of cabbages set apart in the kitchen-garden for the exclusive winter use of the poultry. No one need fear that they will be spoiled by the frosts, although contrary to a pretty generally held opinion; cabbages, especially the "drum-head" or cattle variety, are very hardy, and although the outer leaves may decay—as they often do, hence the opinion that they do not keep—the inside will keep fresh and sweet all the winter through; even delicate sprouts will keep. The poultry relish green food at all times; but in winter, when their outside supply of it is naturally short, they seem to relish it even more than in summer. A turnip with the leaves left on, or a beetroot, will also be pecked by them with great gusto; but a well-hearted cabbage is their special delight, and it does them good. In the feeding and general winter management of the birds, care of course must be taken so *to arrange and modify what may be called general or ordinary rules according to the purposes for which they are being reared;* what, for example, will do for those birds which are to be fattened, say for the Christmas market, would not do for those destined to lay and to keep laying, for an overfat fowl ceases to lay—cannot, indeed, in some cases, and greatly to its physical discomfort, and often indeed torture. The capability to *select fowls for fattening* depends as much upon knowledge gained from experience as that gathered from various sources as to the presumed or assumed fattening aspirations of any breed well known to have these, or said (two different things) to have these.

Having, then, learned to select, and having selected, the chickens which will fatten the best and the quickest way, the great point to bear in mind is *to keep the birds in a gradually improving condition;* regularly fed, but never overfed, upon good sound food, supplied with abundance of pure sweet water, well-housed in clean kept and well-aired houses, yet warm and sheltered, and specially free from damp, the birds will go on increasing regularly in size and weight, and getting uniformly developed in body. Attempts to rear and feed young birds for fattening by fits and starts will only succeed in making them "poor things," not worth even the trouble of the happy-go-lucky treatment which it is their unfortunate lot to receive. Like cattle—to compare great with small organisms—no retrogressive steps must ever be

allowed; for what is lost in "condition" by such is never regained, be the succeeding treatment as good as it can be. Reared, fed, and managed as we have thus briefly pointed out —for did space serve us we could say much more on this subject—the birds will be brought to the period when they will be ready to be "put up for fattening," for receiving the final polish off, which will make them the plump, even-fleshed, judiciously fat, delightfully juicy, and delicately flavoured birds which are the favourites of the gourmand and the housewife alike, and which bring, as they ought to and surely will do, the highest price to the farmer, thus yielding a pleasing result to all round—save to the bird itself, of which we shall say nothing, unless it be what one did say of birds such as those, that they ought to be proud to be killed and eaten, being so well fitted for the latter pleasant process. *To keep up a supply of eggs for sale during the winter months* is a much more difficult task for the poultry-keeper than the fattening of those reared and fed for the table only. Nor need this be wondered at, as the season with us brings with it circumstances so opposed to those which are the characteristics of the natural or original habitat and habits of life of poultry. We have already alluded to this peculiarity in poultry; one would have thought that by this time their original characteristics would have been, so to say, "bred out" of them. But although, in the case of other live stock, by certain systems of breeding their characteristics can be modified and changed, with poultry the same result does not follow the same process. Now in their original condition poultry lay or are disposed to lay all the year round, so that winter should be no exceptional period. That it is so with us arises wholly from climatic reasons. We have shown or hinted at methods by which the difficulties arising from such can be greatly overcome; and we have in our own practice been in this so generally and markedly successful, that during the coldest weather even of severe winter we have had abundance of eggs, when our neighbours all round us had not one to spare, and some not one for their own table. But there is another thing in favour of having winter eggs, which is not often thought of, rarely spoken about, and, with only one exception that we know of, not mentioned "in print." This is what the writer in this exceptional literary notice calls the natural law affecting all poultry, namely,

that "it is their nature to commence laying at a certain age, however late the season, or rigorous the weather," "Cold and other adverse circumstances," the writer continues, "may diminish the number and size of the eggs, but it cannot prevent their laying; lay they must and lay they will, when the proper season arrives." The practical lesson to be drawn from this peculiar habit of poultry is, that in order to keep up a regular supply of eggs it is necessary, in addition to the other rules of management already noticed, so to manage that the different breeds will come into their laying in succession, to aid which plan it fortunately happens that each breed has its own particular period of life at which it commences to lay. In describing the breeds, we have pointed out one or two which are such persistent layers that they have earned the title of everlasting layers; of these the Spanish, Brahmas, and Cochins may be reckoned upon as good winter layers, so that with them in many instances the advantage of attending to the general rules of management we have pointed out wil lbe very strikingly, as a rule, exemplified. In the case of other breeds the poultry-keeper must use his or her powers of observation. These remarks apply chiefly to the young birds coming into their laying time, and by a judicious system the succession we have alluded to may be kept up with them, so that while they are laying the older birds, as the writer we have already quoted remarks, will have that "resting time" which seems necessary to all birds in order to promote their recuperative powers, which enables them to be fruitful as good layers, &c., in the succeeding and more genial months yet to come. *To keep up the stock, and to secure this succession of layers* during the cold, raw, and ungenial winter months, it will form an important part of the cares of the poultry-keeper to begin even now, at an early period of the year, so to "nurse" and attend to the management of the birds which have attained maturity, that they will become early "broody," and thus sitting soon will have "hatches" at such a time that the chickens will be ready in the winter of next year to keep up the laying. This will require to be done with judgment, as may be learned from what we have said on the subject, so that the succession will be maintained in unbroken order, and the "egg-basket" always kept full from which to draw supplies for market, when supplies will bring

back to the farm the best of prices. Some poultry-keepers object to the custom of having early broods, maintaining, as their reason for so objecting, that the chickens are seldom if ever reared, or, if they survive all the ills to which they are specially liable during the early spring months, when the east and north-east winds prevail, that they are poor and sickly, and in fact not worth the labour, anxiety, and cost which they have involved. But this objection is founded very much upon, and the losses alluded to brought about mainly by, the careless system too frequently the rule in poultry-yards, under which, in addition to the want of proper provision to secure the comfort and health of the birds and their broods, the latter are left almost wholly to themselves, and allowed to be brought up as best they may. But if, on the contrary, all the precautions are taken, and all the means provided which we have pointed out, and others which will suggest themselves in the course of the daily work of the poultry-yard, there is no doubt but that even the chickens of very early hatches can be brought up to maturity, and brought up well and sound with little if any losses greater than the general average of later hatches, with all the influences of warm and genial weather, &c., in their favour. There is no necessity why early hatched chickens should die off if they be well attended to; if they be not, the blame must be placed at the right point. There are those who are successful with early chickens; and if some, why not all, or the majority of those who try? there is no exclusiveness in the matter.

The reader will have noticed that what we have already given has had reference chiefly to the winter management of poultry—a period of the year during which the best methods require to be adopted as regards housing and feeding, and the greatest care given to the birds of various classes. Before giving the very few sentences which will be required to embrace the details of summer management—a period when the birds very nearly keep themselves if they have a good "grass-run," which in suburban farms will always be given them—we have a few important points on the general subject still to consider, the first of these being *the fattening of fowls for the market*. There are various methods of doing this, either giving them their food, so that they take as much or as little as they choose, or forcing them to take it—the

"cramming system." And there are also various kinds and mixtures of food. But of nearly the whole of them it may be said, that they have a tendency according to their peculiarities to bring the birds into a state, if not of actual disease, at least one in which there are the premonitory symptoms of it, and of course it follows that the flesh and fat of the bird so treated will be more or less unhealthy. Hence it must be the careful study of the poultry-keeper to carry the fattening process not a step beyond that which is necessary to give them the plumpness, size, and weight which we deem best and most appropriate for the class or breed of bird being fattened and for the purposes of the table. As a rule, fourteen to sixteen days ought to complete the fattening, that is if the birds have been properly brought up to the fattening point in the way noticed at the beginning of the last paragraph. To aid the process the birds must be kept quiet and as much as possible in the dark—not absolutely in the dark, but with just sufficient light to enable them to see their food. But if they are subjected to the cramming, "will ye, nill ye"—"better not say no!" process, as the poor creatures have nothing to do of their own will and pleasure, they may be and often are kept wholly in the dark. In this case, and with the cramming system, the birds are fed, we should say stuffed sausage fashion, only once a day. We might here give a number of recipes for food for the fattening process, but space does not admit of it; only one hint we have room for: all foods, or rather mixtures of foods, ought to have as a constituent animal food of some kind or another, either in the form of flesh or of fats.

It may be said that it is always seasonable to fatten birds designed to be killed and sent to the market; for fine, tender, juicy, fed young birds there is always a great demand, but there is so specially during the trying months of winter, when sickness prevails, and not a small per-centage of families in a district have one invalid at least within their homes, to whom "chicken meat" of this kind is a great treat, and, perhaps, the only thing which will tempt the appetite. Hence such good prices can always be obtained for well-fed birds, that it will be well worth the suburban farmer's while to devote more than usual care to have a good supply for the market at this season.

That some birds fatten more rapidly than others is what is

found in all departments of the farm live stock; and just as in the larger kinds some breeds and mongrel crosses will never fatten, no matter how good the food and how abundant, so that care in selecting animals of the proper kind to give the quickest and best results at the least expense is demanded of the poultry-keeper, in like manner it is found in the case of poultry, although, perhaps, there are fewer really incorrigibly bad feeding cases met with amongst the breeds. There are of course breeds best adapted for fattening, although even amongst the crosses and birds of no particular breed an experienced hand will very speedily tell, on examining and handling any bird whether it will be worth its "fattening keep" or not. To secure success in fattening economically, the birds must be so fed and attended from their early chickenhood that their condition will go on gradually improving, so that when the time arrives when they are to be "polished off" for the market, they will be in the best possible state for that purpose. There are various methods in use for the final fattening. We cannot say that the confining of the birds and cramming system approves itself to us, as one consistent with the principles of physiology, to say nothing here of those of common humanity; yet it is largely followed, and by those whom we should have no right to stigmatise with the charge of being cruel-minded or indifferent to the sufferings "even of a bird," or the meanest thing that lives. Still suffer the poor creatures must, when meat of a highly nutritious and stimulating kind is forced down their throat, with a special apparatus, too—*proh pudor!*—and yet suffered to take none of the exercise which, of all the live things about a farm, poultry so greatly love. The meat, which under the system already alluded to, carried carefully out, of good food and good management, may be supposed to be up to and at the fattening point of good sound quality, must we think undergo a change, and that not a good one, under the unnatural system of confinement and cramming. Even where "cramming" is not resorted to, but high feeding with confinement only followed out, the quality of the meat must, we are inclined to think, deteriorate. It is well known that the "obese system," as it has been called, gives a tendency to apoplexy in all animals, cattle as well as the "smaller fry" of poultry, with a further tendency in those to inflammatory diseases; this can scarcely be said to be an

improving process for the flesh or meat. We have thought it right to advert to these points even in the brief way we have done, leaving the reader to judge whether we are right or wrong, and to decide whether he will be influenced by them. We incline to think that a modification of the system might be adopted, in which the poultry, while they are highly fed, say three or four times a day, shall not be forced to eat more than they seem inclined to take at each meal, should have a reasonable amount of exercise in their own special yard, but be confined for the major part of the day, inasmuch as not only exercise but exposure to cold are quite opposed to quick fattening. The food given should of course be chosen for its fattening constituents, such as ground Indian corn or Indian corn meal, rice, milk, &c. A whiteness in the flesh is considered an essential for the modern taste of the market, and is supposed to be indicative of its high quality and fine flavour, although it by no means follows that this is the case, as we know, *au contraire*, that the highest and most delicate flavoured of bird food is what the Chinese call "black meat," or game. Still, seeing that the taste, fancy, or, if the reader will, sound physiology points to white flesh in poultry as the best, the food will require to or should be such as will give this quality. Now of all liquids milk is the best for this purpose, and of all solids probably rice stands at the head of the feeding stuffs at the command of the poultry-keeper. It is essential that the food, of whatever kind given, should be in a perfectly fresh and sweet condition, any approach to acidity in it being merely an approach to a process of thinning, or the reverse of fattening, the birds. Further, all sloppy, thin, and especially watery foods must be avoided, and if not absolutely dry, still at most a moistish condition of the food is that to be aimed at. From what we have said, the copious drinkings of cold water which fowls, if allowed, indulge in must not be granted them; but their drink must be confined to moderate potations say of milk (sweet), or the water in which the rice has been boiled, a little sugar being added to it, which will not only remove its inherent flat insipidity, but tend still further to fatten the birds. The confinement, which seems a "cruel necessity" of all methods of final polishing off for the market, is best carried out in special coops; these should be as roomy and comfortable as consistent with the system, and, we need scarcely say,

clean as a pin. Such may be taken as a general statement of the method of fattening fowls on what we may call a modification of the "cramming" system, approaching as nearly as possible to the natural system. Details of the "cramming" system will be found in special works.

We now come to the management of *broody or brooding hens*, and the various details connected with the *making and placing of nests*, the *setting of the hen*, her food and treatment while sitting, &c. A great deal has been said about nests and how to make them; perhaps much more than is necessary on what appears to be a very simple matter. But in the artificial way in which poultry are reared, as we furnish the hens with nests, in place of their finding out places for and making their own, as they do in the natural state, or in buildings such as old farmhouses and the like abounding in odd nooks and hiding-places, we are all too apt to make the said nests with notions squaring with our ideas as to what the birds wish, in place of trying to find out what they themselves desire to have. As a rule we have found in our own practice, and observed it in that of others, the brooding hens, if allowed, and there be "ample scope and verge enough" in the places to which they have access, prefer to find out sitting places for themselves; and it is surprising with how small an amount of material to form their nests in such cases they are satisfied with. When hens thus find a place, they rarely if ever show any desire to leave it, and as a rule the birds they rear are healthy and strong. Such places self-found are nearly always in some secluded out-of-the-way corner, usually dark or darkish, thus indicating a desire which we know to exist amongst them to be alone and quiet. If, on the contrary, the hens have no chance such as above noted of finding nests for themselves, and nests are provided for them in the poultry-house, and these made, as they generally are, of prim-made, prim-set, and therefore prim-looking boxes, we have also found that these are not liked by the hens, and that if compelled to sit in the poultry-house in that part set specially aside for sitting hens, they will much rather prefer to sit in some old battered box or basket, if that be present or can be got at, to the fine sitting-boxes alluded to. The sitting or hatching boxes or cribs are generally made close and confined, whereas a hen apparently likes to have an open, or at least a free space before

or around her; and if she goes into a close hole it is her own choice, and she will have wise reasons for it. The materials for making nests with has formed a fruitful subject of discussion. The worst, and which at all events may be safely discarded, is long straw. If straw be used at all it should be cut into short pieces, broken or soft straw being better than hard; the short straws or pieces rather allow the eggs to get settled together, yet not to lie too closely, while when the chickens come out they do not entangle in their legs and beaks, as long straws do, and lead to bad accidents often. We have found old but sweet sound hay much better than straw, although even it should be cut. The bottom of the nest should be rather rounded to prevent the eggs from being scattered, and—as is often the case with fussy hens, who are fond of shifting and moving about their eggs—sent beyond her sitting space and get cold and often spoiled. Capital nests can be made out of pieces of stone, of brick, or of wood, enclosing the material of the body of the nest, and these placed on the ground are liked, we have noticed, as well as more trimly made affairs. There seems to us no doubt of the fact that hens prefer, as we have already said, anything old and out of the way to bran new or trimly made box-nests, &c., and especially if they find these out for themselves. Round-bottomed, earthenware vessels, filled with soft short straw or hay, make good nests. Some maintain that a green sod ought to be laid at the bottom of the nest, for this reason, that under actual circumstances hens must make their nests on the ground or grass, which must be damp; but if it be observed, it will be found that when hens choose nests in the open air they are almost invariably at the foot of a fence or hedge, and in a hollow place filled at bottom with dry soil, sand, &c. We have tried the "green sod system," and found it, as might have been expected, always a failure; and no wonder, the damp always rising, naturally preventing the eggs from being kept properly warm. When the sitting hens are fairly settled, and their sitting-places in rambling old buildings discovered—no easy matter at times, so cunning are the old fowls—precaution should be taken to keep them undisturbed, especially against combative hens who may have taken fancies for the nests of their friends—events which give rise to deadly combats, and if not broken heads, broken eggs.

The supplies of water should be carefully attended to, as also that of the meat, and everything done to make the long dreary sit of the poor hens as comfortable as it can be made. Care must be taken to provide dust-baths, and these under cover protected from rain and snow, which if allowed access will make the dust into mud baths very rapidly.

As to *the best food for sitting hens*, each poultry-keeper has his or her own notions; that there is a large drain upon their system through sitting so long and so close is evident by observing the condition of the hens when they finish with it. Good food once a day when they come off the nest, which they usually do in the morning, is therefore necessary.

In the hatching department there are often grave offences laid to the charge of the sitting hen, such as breaking and eating her eggs, kicking and scattering them about, or, what is, perhaps, the worst of all, after sitting with most exemplary patience, and conducting herself with all the propriety expected from a well-bred hen, and yet without any previous warning and without any reason so far as can be known, she will leave her nest and go out to the yard or run, and commence picking and crowing as if these were her only duties. If, however, inquiry was made into the matter, it would be found, we suspect, that the fault lay with the poultry-keeper, and that something was wrong, or had been neglected and overlooked, thus inducing the hen to leave her duties, which, as a rule, she is peculiarly attached to and attracted by. This fault above noticed often arises from choosing a hen to sit which is of a restless, roving disposition, in fact, not a good sitter. More attention should be paid to this, and if paid the difficulty will be overcome, if indeed it ever arises with some birds. In connection with this point we may state that we have found whenever a hen was forcèd, so to say, to take to a nest of our choosing, she would at some time or another leave it, although at first it seemed as if we had got her reconciled to it. If a hen has the opportunity and chooses her own nest, she rarely, indeed as a rule never, leaves it, even although she may belong to a breed of bad sitters. Hens are "queer crayters," as a servant once called them in drawing our attention to an odd freak of one; and assuredly their ways and goings on are worthy of being observed, so that probably the fact of even a bad sitter having the chance of choosing her own nest, induces her to sit, and to keep sitting

as a point of honour. Again, in some instances, hens will not sit in their appointed place, or for after nearly the period of a whole sitting will leave it, in consequence of their being dissatisfied with their eggs. If she be restless, and keep turning her eggs over and over, working amongst and scattering them about and sometimes out of the nest, she is not pleased with them, and will not likely sit out her time with them.

Hens are very fond of fine, large, and pretty-looking, white and clean eggs, and should a number of birds be "set to sit"—as the awkward phrase is—in one place, dire mishaps arise, often from this desire manifesting itself in one or other of them to steal the eggs of a neighbouring sitter, whose eggs are prettier and nicer, or as she fancies them to be such, than her own. Serious single combats are often the result of this curious desire of hens to have eggs other than their own, which incite the others, so that a "free fight all round" is not seldom the result, in which it may be supposed the eggs do not come off quite unscathed. We have dwelt somewhat upon these points, inasmuch as amidst all the disappointments which the poultry-keeper has to put up with in the course of the year, there is none, perhaps, so disheartening as that a nice lot of eggs should be spoiled, or broken, or half sat through, being left early some coldish spring night by the hen in one of her whims, and found next morning by the keeper dead cold. Eggs thus left rarely come round again, even if put at once under a good sitter; some chicks may come out, but the hatch as a whole will in all probability be a poor one. It seems to be one essential to success in securing good hatches that the mother-warmth should be maintained in unbroken continuity. Good sitting hens know this, apparently, for it is surprising how quickly they take their meals when they come off the nest at their usual time, as if they were quite in haste to be back to their duty.

The eggs selected and put aside for sitting should be marked with the date on which they were laid, this being done in pencil in small figures, so as to be easily wiped out, as they must be given to the hen as pure and clean as possible. This dating of the eggs is necessary in order to obviate the risk of having eggs too old; their age should not exceed fourteen days, but the fresher they are the better. They should be kept in bran, in a warmish place, carefully

avoiding damp. Each egg should be quite free from contact with its neighbour, and not placed on its side, but stuck into the bran so as to stand vertically, care being taken to have the pointed or small end downwards. The various lots should have separate keeping-places, so that if purity of breed be attempted, or the progeny of a favourite hen be wished for, the lot of eggs can be picked out at once. Before setting the hen with her proper eggs, she had better be tried with spoiled or addled ones, or with dummy eggs of earthenware, to test whether she is really "broody" or not. A hen will give the peculiar cluck, or crow, or gentle cry, which indicates broodiness, or a desire to sit, in many cases some time before she is thoroughly or properly broody, the cry being thus merely an indication that she is becoming so; hence the advisability of testing her before giving her good and valuable eggs, which she may leave in a short time, and thus spoil.

When the hen gives unmistakable evidence that she is broody and will sit, the eggs set apart for her should be finally examined before placed under her: first, as to the marked dates, to make sure that they are not too old; and second, as to internal condition, that they be not addled or likely soon to become so. This is best ascertained by holding each egg so that the upper, that is the widest diametered or broadest, end be exposed, whilst the lower and narrow end is covered by the hand. Arranged thus the egg must be held before a strong light and looked through, so that it will be seen whether the air bag or bubble is present in the interior; if it is not, which is indicated by the substance within the shell showing itself uniformly clear throughout, the egg must be laid aside, as it will not produce a chicken, however long the hen might sit upon it. But if the air-bubble is distinctly seen at the crown or top of the upper end, the egg is good. The position of the air bag or bubble, is not always the same; sometimes it is exactly in the centre, or nearly so, of the crown, sometimes at the side. As cockerels in too great numbers in a hatch, or if present in some hatches at all, are not favoured strangers whose coming is looked for by the poultry-keeper, it has been from time immemorial, we suppose, a great point to be able to know, by looking at the egg in the way we have above described, whether or not it will produce a cockerel (male bird) or a

female bird. The position of the air-bag is said to give this guide or indication of sex. Thus, if it is at the centre of the crown, the egg will produce a cockerel, therefore, as a rule, to be discarded where hens are wanted, their mark being the air-bubble to the side. We suspect there is more fancy than fact in this theory; but the importance of the knowledge whether an egg will produce male or female birds is obviously such as to justify all attempts made to find some rule by which it can be found with a fair average degree of certainty.

One of the vexed questions of the poultry-yard is the number of eggs which a hen should have to sit upon. The favourite number is the "baker's dozen, thirteen;" but why this should be so widely chosen it is hard to say. The choice cannot be made from motives of superstition, for if it be unlucky, as some say it is, for thirteen people to sit down together to dinner, it ought, one would fancy, be as unlucky to sit a hen upon thirteen eggs. To be sure, that sage authority, Rory O'More, says there is luck in odd numbers, but then why not nine, eleven, or fifteen. Joking apart, the truth is, there is and can be no set rule to decide the point. The decision rests upon two points—first, the size of the eggs, and, second, the size of the hen that is to sit upon them. Still, in defiance of what one would say is a common-sense way of deciding the matter, some will set a small hen to sit upon the same number of eggs and of the same bulk as will be given to a bird nearly as big, as plump, and well feathered again. But no matter what the data for deciding the point, some will put, as a rule, too many eggs under the hen. The story of the little boy and the nut-jar should be borne in mind by them—it is worth repeating here. The lad was to have one opportunity only of taking as many nuts out of the narrow-necked jar as he could hold in his hand. In his greediness to get the most, he grasped so many that his extended fingers could not get out of, although empty they could be got into, the jar. He, therefore, in place of dropping a few, dropped them all back again, intending to take fewer the next time. But he had only one chance given him, so that he lost his expected trial. It was a good test of character, by the way. We do not say that the poultry-keeper, anxious to have the greatest possible number of chickens from one sitting, will, by putting too

many eggs into the nest, like the boy with his nuts, lose all by grasping at too many; but the almost certainty is that some will be lost through the hen not being able to cover them all sufficiently. Nor is this the only risk of loss being incurred; for even supposing that all the eggs produce healthy chickens, they may, and likely will, be so numerous that the mother cannot cover them with her wings, so that they can have the necessary warmth and shelter from the cold; and in this case some deaths will be the result. The mortality amongst chickens from this cause alone is much greater than is generally supposed. For however good the house accommodation may be, warm, dry, and in every sense comfortable so far as we know—for we can only conjecture at the best what is real comfort to the living things entrusted to our care—still there is nothing which can act so beneficially on the young chickens as mother-nursing, and the comfort they obtain from the shelter of the mother's wings and the warmth from the mother's body. Some are so fond of having large hatches, that in their eagerness to obtain them they put so many eggs under the hen that the very object in view is defeated, by many of the eggs never being kept properly and continually warm, the hen not being able to cover them all completely. We believe that more certain hatches of stronger chickens are obtained by putting a moderate number under the hen. We made it a rule to put eleven; much, of course, depends upon the size of the eggs.

When the hen has sat her appointed time—twenty-one days, a note of the day when she fairly took to sitting being taken—the poultry-keeper's care increases; yet too much is often made of the hatching. Some make a great work about hatching when that period arrives, deeming it necessary to help nature to a large extent in bringing the young birds into the world of the yard; and after they are brought out, doing all sorts of odd things, and administering all kinds of singular foods, preservatives, or the like. Now, as a rule, more harm is done by this "fuss," as some have contemptuously termed it, than good; and if the hen is simply let alone, she, Nature, and the chickens themselves will do all that is required. No doubt in some cases of difficult hatching, Nature and the chicks will require to be assisted to get out of the shells; this, however, seldom is the case with strong, but only with weakly, chicks. A slight enlargement

of the aperture, or even a chip in the first instance given to the shell is all that is needed. When they are all hatched the chickens should be left quietly with the mother for about four-and-twenty hours, care being taken, however, to leave them to their happy selves with a clean nest; all the egg-shells, spoiled eggs which have come to grief and yielded nothing, being of course done away with. Some consider it quite an essential proceeding to give the young chickens immediately, or soon after being hatched, a pod of pepper. We need scarcely say that this is unnecessary—nay, it is worse, for it is much more likely to harm them than do them good. Before giving the young chickens their first food they should be examined as to their bodily condition; frequently their bills are glued, as it were, together by the gummy substance of the egg, or this may appear only as a scale at the side of the bill; but in either case it interferes with the ready picking up of their food, and should therefore be removed.

As to the *first food to be given to chickens* there is no end to the list, each keeper fancying there is some particular virtue in his or her kind or preparation. We much doubt if there be two better mixtures to choose from than bread crumbs mixed with hard-boiled eggs, crumbled and mixed well together, and slightly moistened with milk; to this may be added a little oatmeal to correct the binding tendencies of the crumbs and eggs. The second mixture is still more simple, being merely oatmeal moistened—not made sloppily wet—with milk or milk and water. Their drink should be abundantly supplied, for young chicks are thirsty "topers," and early take to drinking, and the best and safest is pure and clean water. As they are somewhat inclined to take a bath at the same time as they drink, and thus get themselves wetted, which makes them cold and shivering, the water should be given to them in vessels into which they cannot get in amongst the water, or, if open, some clean pebbles should be put into the vessel. All poultry are fond to excess of buttermilk—not other milk which has turned sour, but milk from the churn; this in moderate quantities may be given to the chickens as a treat after their water. Chickens, like children, require to be fed very frequently, and they are quite ready for late suppers or very early breakfasts. And it is marvellous how rapidly they learn to distinguish the footfall of the food purveyor from any other, and rush out

with expectant eagerness for what she may have and ought to have to give them.

We have used up the space at our disposal so completely with the details of poultry management which are essential, that we can only give the baldest outline of the different breeds and their peculiarities. Of these, however, much will be supplied in the illustrations accompanying. For farm purposes the "barn-door," or "common fowl," is (see Fig. 27), taking all circumstances into consideration, the best

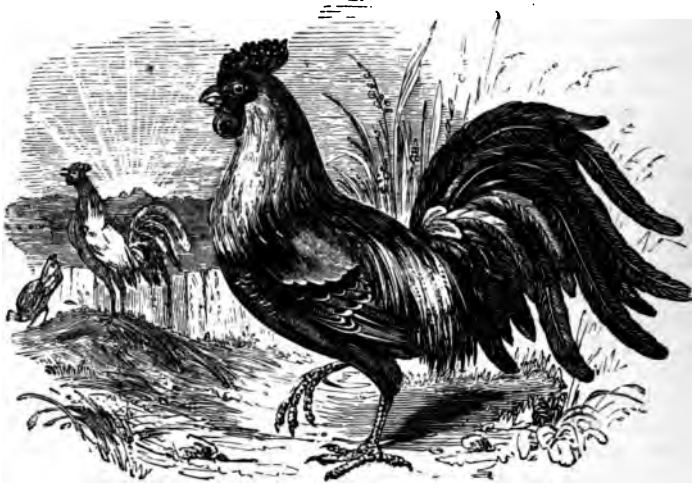


Fig. 27.—Barn-door Fowls.

breed which can be taken in hand for Suburban Farming. Strictly speaking it is no breed at all, simply being a long and varied intermixture of other breeds. They possess, however, many valuable qualities, being generally good layers, sitters, mothers, and capital birds for the table. They do not all, of course, possess these qualities; but as they will be kept in large numbers on the farm the choice will be varied, and very little observation will be required to enable the poultry-keeper to choose those birds which are the best for the special purposes required. When the farmer undertakes the breeding and rearing of pure-bred birds, separate compart-

Fig. 28.—Dorking Fowls.

Fig. 29.—The Polish Breed.

Fig. 30.—The Spanish Breed.

ments will be required for each breed, for obvious reasons. When the highest degree of skill and care is given to this work it may be made very profitable, as large prices are obtained both for eggs and for the birds when of the purest "strains;" more especially if an "outlook" be kept for the introduction of any new variety, for which fancy prices, often equivalent to what would purchase a pony phaeton and a pair of spanking animals to drag it, will not

Fig. 31.—Silver-spangled Hamburgh.

seldom be obtained. Of the numerous breeds now kept we have only space to name the following. The *Dorking*.—This may be called *par excellence* the English breed (see Fig. 28), and may be usually and easily distinguished by the five claws on the feet, one of which, however, is not full-sized. The colour of the hen is either white or speckled; the cock has varied and beautiful plumage. The Dorking is a capital layer, and so good a sitter that the propensity is rather a trouble at times, but it may be usefully availed of by em-

ploying the hen to hatch the eggs of other breeds. Being a short-legged breed, they thrive best on dry soils, and the form is well suited for fattening for table purposes; the only ob-

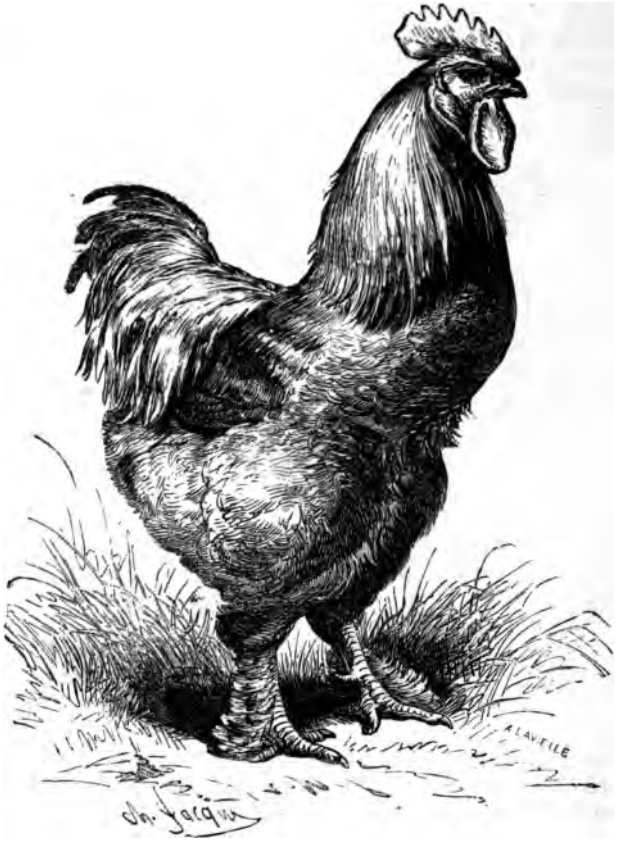


Fig. 32.—The Cochin China Cock.

jection for their use as such being the colour of the flesh, which, inclining to cream, has not the pure white which fastidious purchasers require and give high prices for. The

Polish (see Fig. 27) are easily distinguished by the peculiar top-knot or crest. It is of two varieties—black with the crest white, the other golden-spotted and crest dark. They are such capital layers that they are called "everlasting layers," but they are very bad hatchers, having comparatively little or no disposition to sit. Like the Dorking they are short-legged, and have plump bodies. The *Spanish* (see Fig. 30).—They also, like the Polish, are such good layers that they dispute with them the title of everlasting layers.

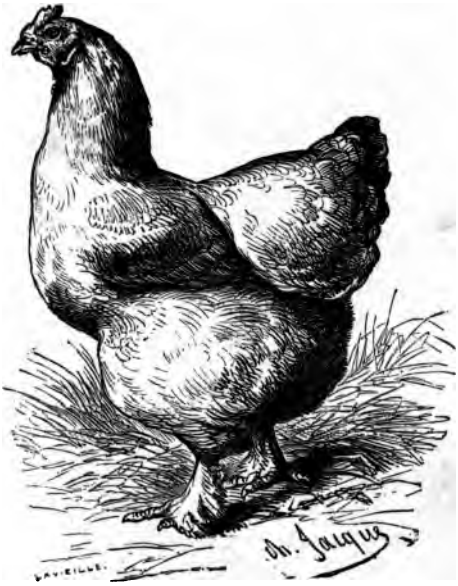


Fig. 33.—Cochin China Hen.

The eggs are large, and the flesh is usually not so much esteemed as that of other breeds; still it is a capital bird for the table, and thought highly of by others. Like the Polish they are bad sitters. The *Silver Hamburgs* (see Fig. 31).—This breed is of two varieties—the silver-spangled and the golden. The Silver Hamburgs are small in size, but are good table birds. The hens begin to lay very early, and although

the eggs are small they begin to lay in great numbers. *Cochin China* (see Figs. 32 and 33).—This bird is of comparatively recent introduction, having been imported from Shanghae. They are huge-sized and ungainly, ugly-looking birds, but their flesh therefore makes up in its bulk for its ugly colour (yellowish tinge), and often somewhat decidedly tough. Although good layers of large eggs, their propensity to sit is so decided that the number of eggs laid by them is not so great; as mothers they are almost unsurpassed.

SECTION III.—GENERAL FARMS.

CHAPTER I.

AUXILIARY FARMS—GENERAL POINTS TO BE ATTENDED TO.

THESE farms are intended to supply any deficiencies that may occur in the productions of the first-mentioned section of the work, namely, "Milk Farms," and of the most early articles of consumption, and to contribute very largely to increase the general supply of the articles in daily and constant demand. The position of this class of farms must be outside the last class of productive lands, and the distance may be six to ten miles from the nearest depôts of delivery at the cities and towns. The quick transit that is now available on railways makes the difference to be very small between the articles in their capability of enduring the damage arising from exposure and handling. Milk is the only article that absolutely demands the nearest possible proximity to the place of production and of consumption, and consequently is better confined to the one locality nearest the town (see Note on Transit of Milk, Cooling of ditto). All other articles that have been mentioned may be produced in this the third-class

farms, as the distance of two miles is almost as nothing in the rate of speed now adopted on railways, and the articles not being easily injured by handling can be transported without damage from the distances that have been stated. The average extent for these farms may be reckoned at about 400 acres, which will allow not only of the production of the articles in the first-rate management, but also of a display of general farming in the most advanced practice of the present time. If the land exceed the medium quality in value, it may remain to be managed by the best known rules of husbandry—in thorough draining, if its condition requires that operation to be performed; in being divided into fields by a neat fencing of 15 to 25 acres in each compartment, and furnished with sufficient roads of communication, and with the buildings required as a farmery, as will be illustrated, a dwelling-house for the manager, and cottages for the labourers. If the land be of a decidedly inferior quality, the improvements must be effected that have been mentioned, in deep digging of the ground, and in liming the land to open up the particles of earth, and reduce the whole mass into a state of fineness of tilth in order to promote the cultivation of root and forage crops, if not of the finer kinds of turnips, at least of the grosser plants, as potatoes, beet-root, and cabbages. This alteration, though dearly purchased, will prove of incalculable value, especially in the present case, in which root plants are a chief commodity for the special purpose. The subsequent cultivation of the land by the application of farmyard dung, or with animal and vegetable matters, will very soon form a soil of the first quality, and that from almost any of the original formations. These most necessary improvements must precede the

occupancy and laying out of the farm for the special purpose in view. Upon the most perfect execution of each of the points of the work of improvement will depend the success or failure of the undertaking; the contrary will give rise to the misapplication of capital and labour—the two most valuable of human possessions —and the aggravated feeling of not having exhibited a specimen of an enlightened practice in the cultivation of land, worthy of being considered and followed by others connected with the art of agriculture. This last consideration will operate with all generous minds with an equal if not a greater power than the reaping of pecuniary profit and also of social benefits, though both consequences must have a large share of consideration. The primary expenditure in such cases is not the chief principle of action, but the ultimate result—not the amount or extent of means to accomplish the purpose, but the correctly estimated value of the object that is in view, and then the direction and application of the materials in the ample quantity that is sufficient to overcome all difficulties. True economy consists, not in getting things cheaply done, but in getting them well done—not in a pinched starvation of the means applied to effect any purpose, but in the rules and regulations that are adopted for the distribution of the materials and of their direction to the special purpose. True economy, or the "wise distribution of labour," is no less the rule of the farm than of the household, for the due regulation of its actions and performances.

The farms that are now to be described being intended for the production of special articles in the highest perfection under a partial restriction, and also to exhibit examples of practical agriculture in consonance with the most advanced ideas of the present time, in the greater

number of the various operations the constitution of the establishment and of the management of its proceedings must be conducted on the most enlarged and comprehensive system. The regulation of the crops to be raised on the lands come into an early notice, for the purpose of obtaining the special articles and for the maintaining the necessary fertility of the land. The course of four years appears to be the best adapted for the production of special crops, or of new plants (see note) in constant alternation. But except in the case of the very best lands in quality, the constant ploughing of the land is deteriorating to its productive powers; and as a rest in the rotation is refreshing and invigorating to the land, a course of five years has been devised and is very much used on all medium qualities of land, which rests the soil for one year after the crop of hay, by the grazing of the herbage with store cattle and fattening stock. This arrangement forms a very valuable consideration in the rotation, which is supported by the approval and practice of the most eminent practitioners in the art of agriculture. Thus—

1st year. Root crops—in Swedish turnips, potatoes, beetroot, and cabbages well dunged in drills, thoroughly cleaned from weeds, and the soil broken and pulverized.
2nd year. Barley.
3rd year. Hay.
4th year. Pasture.
5th year. Oats.

CHAPTER II.

ROOT CROPS—TURNIPS—POTATOES—BEETROOT—BULBS.

Root crops being the highest in value, one-fourth part of the farm may be used for fallow crops, leaving 75 acres for each of the other crops of the rotation. Swedish turnips are most highly valuable from being used in the raw condition by the growing pigs in the storeyard, and in being steamed along with dry chaffs to constitute meals of juicy food for the cows that are yielding milk. No other species of turnips can stand comparison with the green and purple varieties of the Swedish turnip for general use. Potatoes are, in the present case, the most valuable of all the other root crops, and must be grown in a large proportion of the 100 acres of yearly green crops, in 40 acres at least, leaving 60 acres to be used by the three plants of turnips, beetroot, and cabbages, in 30, 20, and 10 acres respectively—all grown on drills, 28 to 30 inches apart, formed by furrows of the common swing plough, the farmyard dung spread along the intervals, and covered by reversing the drills with a double mould-board plough. The turnip seed is sown on the newly reversed ridges of land by a two-drill sowing machine of the most approved construction, and the beetroot on the drills of the same in width or in 30 inches by a sowing machine, or by hand-dibble. Cabbage plants are inserted in the drills one foot apart on fresh tilth of newly split drills,

placed by dibble, and at the same depth which the stalk had in the seed bed from which the plants are newly or recently raised, the fibrous roots being neatly dressed and shortened by hand-knife, and placed in a tub of water with the roots immersed, and planted in as wet condition as possible, and firmly dipped into the soil. The drills of turnips, potatoes, and beetroot are to be rolled with a 5 or 6 cwt. roller for the purpose of excluding drought. These crops must be thoroughly cleaned from weeds by the hand or by horse-hoes, the drills well broken in the fine soil, and the intervals well wrought and followed by repeated applications of the horse-hoe. The success of the following crops will very much depend on the cleaning and working of the land on the root plants. The labour of the potato crop may be very conveniently divided by planting a portion of the land in the late autumn in a similar way with the spring crop; the drills may be made deeper and twice covered with earth over the dung and the sets of the plant, to protect the tubers from the frosts and colds of winter. Experience has now settled the advantages of autumn planting in fine weather. The winter ploughing of the land intended for green crops must be deeply done, and in the early winter, in order that the land may derive the benefit from alternate contractions and expansions from the atmospheric action of frosts and thaws, rains and dry weather, all tending to the pulverization of the soil, as no subsequent workings of the land will supply the want of the early exposure of the soil (see note on Deep and Autumn Culture). The depth of the furrow in ploughing must be nine inches, and the work will be best done by the power of three horses with two walking in length in the furrow, and one walking on the unploughed land with the

advantage of the swing tree and balance, in order to equalise the power of one against two animals. All winter ploughings of land are best done with a power sufficient to raise a depth of soil for the summer operations of ploughings, grubbings, and scufflings. The spring stirring of the lands may be done deeply, but without the exposure of the underground to the action of atmospheric changes by the early winter ploughing. The first of the spring furrowing is done so soon as dry weather permits, and across the winter ploughing, in order to cut and bruise the land into slices as the first step of crumbling the soil. After leaving it for some time to be dried the land is harrowed across and lengthwise by four turns of the harrow, when all weeds and stones are removed by hand-picking before being rolled by a cast-iron one-ton roller, when another harrowing exposes weeds and stones, to be picked off and removed from the field. In this condition the land remains for a convenient time, in order to gather moisture, on the retention of which in the land for the vegetation of seeds very much of the success of green crops, especially of the turnip plant, will ever be found to depend. The husbanding of the winter moisture for the use of the summer vegetation of crops that are planted in the very driest season of the year, is the main point of turnip farming, and requires that all the necessary modes of preparing the land in ploughing, harrowing, and rolling be done as quickly as possible to avoid evaporation, the land lying between the processes in a flat surface is closed against drought, and imbibes and retains moisture. The land is next to be dunged and planted with the crop—in many cases of a stiffish soil; a third ploughing will be required to be done with much quickness and dispatch, and the land must remain

in ready preparation for as long as possible. In this fresh and moist condition the drills are opened at 28 inches distance by the common plough going and returning in the same furrow, throwing a seam of earth to each side, or by a double mould-board plough in one turn. The dung in a moist state, dripping but not losing much water, if any at all, is placed in small heaps from one-horse carts and spread along the intervals, and immediately covered by splitting and reversing the drills by a double mould-board plough and covering the dung, on which freshness of tilth the turnip seed is immediately deposited by a double drill sowing machine. The work of opening the drills, depositing and covering the dung, and of sowing the seeds, must not exceed half an hour, it being of the first consequence to deposit the seeds in a fresh and moist tilth of soil for the purpose of an immediate vegetation. A rolling of the drills with a 5 or 6 cwt. roller will crush the clods and close every orifice or opening in the land against drought as the finishing act of the whole work. On cloddy and crumbling soils this rolling is most imperatively required in order to press the clods of earth into a closeness to exclude the drought, and to press the seeds down in the soil and the dung underneath. On dry lands of this description and especially in dry climates and in dry seasons, the rolling of the drills immediately after the sowing of the seeds must be most carefully performed.

It has been objected that the twice ridging of the land in the driest season of the year exposes the soil to evaporation and dissipates the moisture, and that the sowing of the seeds on a level surface of ground secures a better chance of an early and prosperous vegetation, on which the crops of turnips do very much depend. In certain cases of cloddy, crumbling soils, and in dry

climates and in dry seasons, the objection must be admitted, and in any of the above unfavourable circumstances good crops can be obtained by sowing the seeds on the level surface with two drill sowing machines, having lengthened coulters to make ruts in the ground, to receive the seeds mixed with auxiliary manures as bones and guano, and covered by a roll or a bush-harrow. The crop is managed as in drilling the land by hand hoeing, and by fallowing the intervals with the horse-hoe scufflings. A good method is to make drills with one deep and heavy furrow of the common plough, and split the ridge deeply by the coulter of the sowing machine, and placing the seeds among the fresh tilth of earth that has been moved by the plough. This is very valuable for turnips, and the land being immediately rolled and pressed together forms a flat bed for the seeds and manures in a fresh tilth, a most advantageous position for the early growth of plants. Sowing on the flat surface deposits the seeds in a shallow position among clods and in a dry parched alluvium, which is penetrated but not moved upwards by the rutting coulters of the drilling machine, and consequently the method is inferior in that respect. The farmyard dung is spread evenly over the prepared lands, and ploughed under with one furrow, which is lightly harrowed, the seeds sown by the corn drill machine by coulters at the proper distances, and covered by the bush-harrow. The crop is managed in the usual way. In broadcasting the seeds by hand the plants are cleaned and freed from weeds by hand-hoe; no horse-hoeings can be used, and the soil is not moved nor fallowed, and the cut weeds encumber the plants, as there is no space as between the ridges in drill sowing in which they can lie,

while the feet of the workers tread the ground and damage the plants. Good crops of turnips are raised by this method, but it wholly fails in comparison with the drill system in the most essential point of fallowing the intervals between the rows by horse-hoeing. The hollows of the surface made by the drillings afford a position or bed in which the clods and weeds are deposited from the hand-hoeings, to be destroyed and reduced into a clean and finely pulverised earth by the scuffler and horse-hoe. Sowing on the flat of lands does not afford a sufficient room for that purpose in weedy lands; the scuffler will lay the weeds on the growing plants, and will push earth and clods over them. Though the same width intervenes in both methods, the superiority is very decided in the drill system in working and cleaning the soil. The broadcast method of raising the crop is most miserably deficient in this respect, flat surfaces not permitting the movements of the soil around the plants, which it is well known stimulates their growth.

It may be again stated, at the risk of repetition, that the success of turnip-growing depends almost wholly on the husbanding of the winter's moisture for the use of the crop by getting the preparation of the soil done as quickly as possible, and yet leaving intervals of time between the workings as long as possible, during which the land lies in a level condition to imbibe and retain moisture and to exclude drought. When the young plants are grown to the proper height and so as to be into rough leaf, the intervals of the drills are ploughed with an implement drawn by one horse, having a two-winged share to move the bottom of the intervals, and a winged knife on each side of the beam to pare down the sides of the drills without reaching the rows of

young plants. The hand-hoe follows to push and cut all weeds and clods into the hollows, drawn and re-drawn across the rows of plants at the distance of 8 or 9 inches for singling them, the best plants being carefully selected and left in the soil. The light scuffler is used to stir the soil between the intervals, destroying all weeds and pulverizing the soil. So long as any weeds appear the hand-hoe is used, and to leave such of the turnips "single" which had been before overlooked. The scufflings and hoeings are stopped when the foliage of the plants is spread over the intervals covering the ground, and any tall weeds that rise are pulled by hand, though with a proper cultivation no weeds should be seen. The close covering of the land by the leaves, which imbibe and retain moisture, excludes drought and protects the surface of the ground from the effects of heat and drought; this, along with the fecal exudations that are emitted from the fleshy roots, bulbs, and tubers, all contribute to the benefit which the soil receives from root crops under cultivation.

The cultivation of root crops affords an excellent opportunity for the application of lime to the land. When lime in a slaked condition is spread over a pulverized surface, it runs into every opening, and penetrates the smallest crevice, conveying and imparting caloric to the soil. When this application of the lime is made in spring, and deferred to the last ploughing or to the drilling of the land, and if the season be dry at that most likely period of the year, a very great risk is incurred that the hot lime, along with dry and hot weather, will absorb the moisture and endanger the loss of the crop. This has happened in many cases. To remove this objection and to obtain the advantages of the application with the cultivation that is so very

favourable to the action of lime, an earlier application must be made in April on the rough surface of the first ploughing, when some weeks will intervene before the time of sowing, during which time the land will absorb moisture and receive rains to prevent the scorching causticity of the lime. In these applications the lime-shells must be placed in a thatched heap in a corner of the field to be dressed, and turned over by hand twice before being used in order to secure its uniform dissolution. The crude limestones may be broken to the size of a goose-egg, burned in that state, spread in shell over the land at any time during the preparation, and covered by the ploughings, when the moisture of the land will slake the lime and raise the temperature of the ground, for after all that has been spoken and written on the subject of the action of lime, the chief benefit may be derived from the temperature of the ground being raised by the caloric evolved. The benefit to the land will be in a ratio with the capability of the soil to imbibe and retain caloric in an equable quantity. Clay is a low conductor, and in a pure or partially mixed condition the land receives little or no benefit from lime. Sand receives and radiates caloric too quickly; earthy loams, with a mixture of animal and vegetable remains, receive the greatest benefit from lime, having the power of receiving, retaining, and distributing in an equable degree the essential requisites of vegetation, moisture, and warmth. The excess or want of these requisites constitute the difference in the quality of soils. The stirring of the land by a grubber will very largely contribute to the mixing of the lime with the soil and to the furtherance of its application.

Lime has been applied to land with a good success

by spreading the shells as got from the kiln over the surface at any time of the spring operations of cultivation, and even on the stubble ground of the previous year, and then ploughing them into the land by the winter furrow in November. These methods must be carried out only on good clean lands of the first quality, loamy, dry, and easily friable, with which lime can have affinity of at least some amount, as harsh clay soils will repel any alliance with lime when lying in unbroken furrows, and the lime, from the extreme affinity it has with water, will sink to the bottom of the slices without producing any action. In the very busy season of the year there is not time for the method of dissolving the shells in small heaps on the land, there to be spread when the pulverization of the land has been effected. A mode of application generally useful is the formation of a heap of lime-shells in a corner of the field, covered with soil, the heap being turned over by hand, and pulverized by water when required for use, and spread evenly over the land and immediately covered by harrowing.

The crop of Swedish turnips will be full grown and ready for use in November, when the bulbs are pulled by hand and dressed clean from tops and roots by cutting with a sickle, and carried for use daily as wanted in the homestead as food for store pigs in the yard provided for these animals, and in a steamed preparation with meal for cows, poultry, and fattening pigs. They should be used fresh from the field in the raw state, with as little time as possible intervening between their being taken up and the consumption by the animal, as vegetables lose their good quality very fast in parting from the soil and from exposure. The vegetable freshness is invaluable as food to organic life.

In February in early climates, and in March in later, the whole crop will be removed from the land, the bulbs dressed clean by hand-sickle from roots and tops, and carried in dry weather to the homestead, and stored as potatoes, fully described in the notice of that root. By that method of storing the turnips are preserved to May and June of the same year, and may even be kept fresh to meet the earliest crops of the succeeding year. At all events, the use is certain till Midsummer. The tops that are cut from the bulbs are good food for store pigs, and very useful in forming manure as a vegetable mixture with animal excrements. The fibrous root cut from the bulb, along with the adhering earth, remains on the ground as a valuable item of fertility. The crops must be wholly removed from the field previous to the period for preparing the soil for the succeeding grain crop.

Potatoes

will form a large portion of the root crops that are grown on this class of suburban farms, for the valuable purposes of maintaining swine and poultry and for work-horses. In the raw or steamed condition for horses, and for swine in the store or in the fattening departments, and in the steamed condition as food for poultry, the potato has no superior, and even milch cows may be worse treated than with a meal of steamed potatoes in the condition of a mealy dry mass rather than saturated with water. The potato plant requires for its prosperous growth a soil of deep waxy loam, damp and moist; it does better in a heavy soil than in an open and light one, which admits drought too freely and evaporates moisture too quickly. A good depth of soil on a porous subsoil is an essential requisite.

An early winter ploughing exposes the land intended to be planted with potatoes to the atmospheric changes of the winter and of the early spring; the furrow should not be under 8 or 9 inches in depth. This operation may require a greater power than the strength of two horses, and three will do much better work, and may be well employed in doing all winter ploughing of fallow lands, in order to afford an abundance of soil for the summer operations of cultivation. The practice has been objected to of ploughing deeply in the winter or in the first ploughing of the spring; but a preference may be justly given to the deep winter furrow by its exposing a quantity of under soil to atmospheric action through the many changes of winter. The deep spring furrow exposes the under soil to the action of drought. In the earliest favourable weather of spring a cross ploughing of the land is performed with deep and narrow furrows, in order that no part of the land remain unmoved—well harrowed when dry to expose the weeds and stones, which are hand-picked into heaps and removed from the field. The land is again harrowed after being rolled with a heavy one-ton roller, when the weeds and stones are again picked by hand and removed. Another ploughing, harrowing, and rolling will, in most cases, prepare the land for being planted with the crop. A deep and wide furrow is drawn with the plough by the power of two horses walking at 5 feet distance, and the plough returning in the same furrow throws the earth to the opposite side of the first line. By passing along the sides of the furrows in succession the plough opens a drill of 30 inches, and by returning in the same furrow the ridge is completed. The whole field is formed into drills by this operation being continued. The farmyard dung is brought from

the yards of the homestead in a fresh condition. The dung should be "short," which is best made by having the litter cut into short lengths by steam power, which causes the dung to be in all cases much more conveniently handled, easier spread in the drills and covered in the land, and also more readily saturated with the urine of the animals. The dung is deposited from the one-horse carts, which pass along the drills, into small heaps in every third interval, and immediately spread along the hollows by light hand-forks, and laid evenly and regularly so as to cover the ground with a thick coat. The potatoes should be of the most prolific kind, the tuber round-shaped with an abundance of eyes and of the best white colour, and in as large bulbs as possible, and with a sound "eye" to each "set." Each "set" is placed on the dung in the drills at 8 inches distance, and firmly fixed in the position by a tread of the foot, to resist being displaced and thus make an irregular braird of plants. The ridgelets are split and reversed over the dung by the common plough passing along both sides, with the horses walking at a distance of 5 feet apart in the intervals and on the top of the drills, but reversed to prevent any disturbance of the dung or of the potato sets by the feet of the animals. An acre of land drilled will require 20 one-horse cartloads, and 40 bushels of uncut tubers for seed. The narrow tops of the newly made drills are rolled by a 5 or 6 cwt. roller, and the land remains for next operation.

After the lapse of two or three weeks from the planting of the crop, the light grass seed harrows are passed along the drills in order to break the crust of earth on the surface, and to open the way to the tender shoots of the tubers. This operation of one turn of the light

harrows does not in any way injure the coming shoots of a potato, but very much hastens the growth by opening the surface to its upward vegetation. When a full braird of plants has appeared, and when weeds have made a large growth on the ground, the intervals of the drills are deeply ploughed by a small plough drawn by one horse, which passes along each side of the drill in a furrow not to disturb the dung on the tubers, and lays two light furrows in the hollow of the interval betwixt the drills. The light scarifier with a winged share and cutting knives, already described in last section, follows the process of ploughing, and moves the soil and destroys the weeds. The hand-hoe is immediately employed to cut the weeds, and to break the drills by passing the hoe between the sets of plants, and to move and place the surface soil in a new position. This operation is to be very carefully done, and at least once again repeated when the stems are about half grown in height, when the weeds are very carefully cut and the soil made level. This process also promotes the escape of gaseous matters to be inhaled by the leaves of the plants. The process of scuffling is done at short intervals of time, and the hollows are again ploughed, which may not be repeated, and probably the one ploughing may suffice if the soil be well pulverized and free from weeds. The light scufflings are continued throughout the season, till the leafy branches and the stems close over the intervals and prohibit the work of the implements, when the tall weeds that may afterwards arise are pulled by hand. But a perfect fallow crop does not admit of the appearance of weeds after the season is closed; no growth must be seen except what is sown or planted on thoroughly well cultivated lands. Before the stems are so largely grown as to prohibit

operations being carried out, and after all weeds are destroyed and the intervals of the drills are completely fallowed to a very fine tilth, the intervals are furrowed up by a double mould-board plough, which lays a seam of soil on each side up to the roots of the stems, the implement working deeply and being drawn by two horses walking two drills apart, the plough being in the centre interval. The main draught or whipple-tree of the plough is five feet in length, and stretches over two drills of 30 inches apart, in order that the ends of the main tree be in the straight line of the draught of the horse. This earthing up of the drills is done the second time in about two weeks from the first operation, and both performances must be carefully done, as the benefit is very considerable to the bulk of the crop. The movement of fresh soil affords gaseous matters to be inhaled by the leaves, and gives an earthy level for the expansion of the roots for the production of tubers. It requires a deep previous working of the intervals of the drills to get a quantity of soil for the purpose of the last operation.

The potato plant requires a deep working of the land with implements that are suited to the special purpose. The work being performed in the early season, the land is consolidated by the trampling of the workers and by the effects of the weather; and as potatoes are planted on rather stiff soils both in the upper and lower formations, the necessity is imperative that the land be deeply moved and frequently stirred. The narrow-pointed share of the common plough is by far the best fitted to pierce the soil of the intervals between the drills; having only one point to penetrate the ground, the process is easier and much more effective than any drill-cutting scufflers with several tines that re-

quire a greater power without penetrating so effectively. The light scufflers are useless for the first ploughing or scuffling of the drills, as the tines are not able to penetrate the soil, and are best suited for the lighter turnip lands. Duck-footed coulters and tines with one wing or blade are unable to pierce the ground to any proper depth, and in damp weather among a multitude of weeds the coulters carry along a mass of earth and weeds, with much inconvenience to the work and damage to the young plants. The small wrought-iron plough pierces deeply into the ground, and very conveniently puts aside all rubbish, weeds, and clods that adhere into a mass. The time required is more than by the scuffler, which fills the interval of the drill with one passage and finishes the drill; the small or miniature plough finishes a drill by two journeys along the sides of the drills. But true economy consists, not in getting things cheaply done, but in getting them done well, and in all cases of stiff-bottomed lands the superiority of the miniature plough is most evident. The ploughings and scufflings of root crops are most beneficially done in dry weather, and, contrary to the general opinion, the movements of the soil evolve gaseous matters to be imbibed by the leaves of the plants, and also to provoke fresh combinations between the soil and manurial constituents and the atmospheric agencies.

In the condition of an undisturbed growth, and by hand-pulling of any tall weeds that may arise, the potato crop reaches maturity by the end of October, when the tubers are dug up and stored at the homestead. The haulms of the crop are first pulled by hand and carried to the storeyard for the pigs, to which the roots and the small tubers attached afford some food, and the haulms are thus converted into manure by the best means that

is known. The haulms should be cut into short lengths, as also the straws used for litter, as the haulms resist putrefaction, and the short lengths will be more conveniently mixed with the excrements and the urine of the pigs. A man digs a drill with a three-pronged fork and shakes the earth, and the tubers fall on the surface, to be gathered into a basket by a woman or a lad drafted off to each digger, and deposited in carts which stand in order for the purpose of conveying the crop of tubers to the store heap. In this way the whole surface that bears the crop is dug over; weeds and stones are at the same time gathered by hand and removed from the ground. These advantages are very considerable, the soil and subsoil being pierced and opened up by the narrow prongs of the fork for the permeation of air and moisture. This gives a superiority to the digging mode of raising the potato crop in every way preferable to the turning over the drills by the plough, of which the sole plate sledges the subsoil and closes up its pores or interstices instead of opening them, as is done by the pronged fork. The advantage of digging land over ploughing arises very much from placing the soil in a loose open position, and from the subsoil being pierced by the narrow points of the fork. The land is in fine condition for being immediately sown with wheat when that is used as the succeeding crop of the rotation.

A most unfounded prejudice prevails against the use of potatoes as a root crop, on the supposition that the plant inflicts a damage to the land hardly to be recovered within a reasonable time. It is hard to conceive how a crop that is planted on land that is soundly cultivated, cleaned, dunged, limed, and managed in the scufflings and subsequent drill-hoeings in the best modes, can inflict damages on the land; the abundant foliage of

green succulent leaves imbibes much food from the atmosphere, forms a shade over the ground that receives and retains moisture, affords a protection from drought and waste, encourages and promotes a putrefaction of small vegetation and of minute animal life, all which tend to fertility; and whatever may be the colour of land previous to producing a crop of tubers, the colour is invariably a black or a dark hazel from the exudation of the fleshy esculents. It is true that potatoes require lands of a good quality in depth of soil, dampness of earth, and a larger humidity of climate than would seem to be required from its tropical origin. A shallowness of soil on dry bottoms of rack, gravel, chalk, and sand will not produce results that may be expected from the following process of cultivation, and failures in such cases may have created the prejudices that extend to other classes of soil. In all places of tolerably favourable circumstances of soil and climate, the potato yields a larger quantity of edible matters than any other root plant, leaving the land in a most excellent condition to be sown with wheat, and on which the grass seeds sown in the spring thrive in an acknowledged superiority to every other method of preparing land. These facts and the universally high character of the potato as food for man and beast, from the table of the peer to the cottage of the labourer, should almost wholly do away with the prejudice against it as a crop. Potatoes are stored for use at the homestead by being placed on a dry bed in a longitudinal heap of about six feet in width, and about four feet in the central height of the sloping sides. A frame of lath-wood one foot wider than the heap at bottom, and nine inches more in height, and joined in length by longitudinal bars, will support a coat of straw thatch three or four inches thick to pro-

tect the roots from rains, and at the same time admit a current of air all round the heap by being raised some little above it. The roots must be kept dry and cool; a layer of earth laid over a pile of potatoes only encourages vegetation by the presence of warmth. A sprout in the tubers is equally hurtful to them as food as for the purpose of planting as seed, as the first vegetation is ever the most vigorous and healthy. The potatoes are taken from the heap as required for food, and the lath framework will last for years, being joined in pieces for convenient removal and replacing.

Beetroot

is a most valuable plant on the best lands and under an early climate, as it produces the longest weight of all our root crops. The leaves are abundant and very large and succulent, and afford an excellent food for store pigs, and in the best condition are relished by milch cows when supplied in a moderate quantity. Though useful during a short season only, this supply is very welcome as an addition to the food of the live stock of the farm. The roots are large, thick, and fleshy, 8 to 18 inches in length, but round or flat at the ground as turnips are formed. The juicy nature makes the plant very valuable as raw food for store pigs and for milch cows; steamed and mashed with meals, as of beans and barley, they are also very beneficial to poultry and hogs, and for cows as a change of food. The general opinion estimates the plant as better adapted for milking purposes than for imparting flesh, and consequently they are well adapted for the farms now under consideration, which require store qualities rather than fattening properties in the food for the live stock. The cultivation of beet is rather circumscribed, and does not by

any means attain the wide latitude of soil and climatic conditions of the turnip. Shallow depths of soil are hostile to the plant almost to its entire rejection, and stiff clay lands display the same unfitness for the growth of the root. A climate which has an early spring and an autumn protracted into winter is required to permit the preparation of the land and for being planted with the crop, and to allow the full growth of the plants before winter stops this and endangers the roots and leaves by being damaged by the early frosts. The sowing of the crop is much more difficult than that of turnips; the quantity of manure applied must be large and of the best quality and preparation, and the storing and application of the root is much more laborious and expensive under the circumstances than would seem to be demanded by the nature of the plant and its requirements.

The stubble lands intended to be planted with beetroot are ploughed deeply in the early winter, to derive the benefit of atmospheric changes by the exposure of the soil to the alterations of contraction and expansion, the result of unusual frosts. The power of three horses may be required, as has been recommended in similar cases. In the first dry weather of spring the land is cross-ploughed with deep and narrow furrows, in order to move the soil freely from the bottom; then well harrowed, the weeds and stones gathered off by hand-picking, rolled with a one-ton cast-iron roller, again harrowed, and the weeds and stones gathered. These operations constitute the first part of preparing the land, when lime is well applied if the surface is tolerably reduced into a fine tilth; if not, the half-pulverized shells may be spread over the surface after the next process of cultivation. The second working is done after an interval

by the same operations as have been detailed, and in most cases of a fair quality of soil the land will be ready for the crop being planted. Another working may be required on stiff lands and in seasons of "catching weather." Drills are formed at 30 inches apart by deep and heavy furrows of the common plough, going and returning in the same hollow. Farmyard dung, very moist and saturated without dripping, is placed in small heaps from one-horse carts in the hollows of the intervals between three drills, and spread by hand-forks along the bottoms of the furrows in a quantity that fully and even deeply covers the surface without any blanks, as an even coat of dung is essential to produce an even crop. The ridgelets are immediately split and reversed over the dung. On the fresh tilth thus produced the seeds of the plants are deposited by drilling machines, or dibbled by hand, placing two seeds in each hole, or "pocket." A rolling with a 5 or 6 cwt. cast-iron roller finishes the process by levelling the drills and pressing the seeds into a firm bed near to the dung underneath, and protected against drought by a close covering of earth produced by the pressure of the roll. This point must be attended to, as the land remains for a time unmoved, and in the most favourable condition possible.

When weeds come up, and the young plants have risen to a height of 2 inches, the intervals of the drills are deeply ploughed by the small or miniature iron plough drawn by one horse, moving a furrow from each side of the drills without injury to the young plants, and placing the earth that is moved from the drills in the intervals, to be afterwards wrought and fallowed by the light scufflers, and to destroy the weeds. The hand-hoe next breaks the tops of the drills into a fresh

tilth, among which the young plants are left standing at a distance of about 8 inches apart along the drills. After a proper interval a second hoeing must be done, to cut away any weeds that the scuffler cannot reach, to break up any firm soil around the plants, and to leave only one plant in each space in the drills. In this condition from the hand-hoe, with the intervals of the drills very finely fallowed and clean from weeds, after deep ploughing by the small plough, and the repeated operations of the scuffler, the crop of beet is left to grow into maturity. If any tall weeds arise, the stems are pulled by hand; but none, however, or but few, should be seen, if the operations described have been well done.

The season of taking up the crop of beetroot is generally in the latter end of October, before frosts set in, which injure the roots. They are known to be ripe by the appearance of putrid decayed leaves at the lower part of the top, and a flagging or dropping appearance of the whole. The roots are pulled by hand, the fibres at the root are neatly cut from the stem by a sickle, which also severs the leaves from the crown of the root. Care must be taken to "tail" and "top" close to the stem, without any part of the root being cut, as that will "bleed," or pass its juices, and rapidly decay. The tops are placed in small heaps, and the roots laid singly in order to be dried by sun and wind. When that condition has been obtained, the roots are carried to a raised dry bottom of earths or gravels at the homestead, and placed in a longitudinal heap of 6 to 8 feet in width, and tapered to a narrow top or ridge with a central height of about 4 feet. The roots are placed by hand in the outside of the heap with the root or thick ends outwards, the smaller ends towards the inside being sup-

ported by a layer placed for the purpose. The heap is covered by a coat of thatched straw to the thickness of 2 or 3 inches, well secured at the bottom and at the top or ridge, after the manner of a rick of hay or grain. The sides of the heap are guarded by longitudinal bars of wooden laths, placed at proper distances. Frames of covering made of timber, as has been directed in the case of potatoes, will serve for years for the purpose of protecting beetroots from rains and frosts, and in all cases of covering of fleshy roots. The close covering with heavy earths must be avoided, a close warmth being injurious; a cool, dry, and open condition as possible, so as to admit of the admission of fresh air, is what is to be aimed at. In northern districts, where frosts and snows are heavy, frequent, and of long duration, a covering over the thatch of the heap, when storms occur, of the dung from the stables, dry excrements, or of any short dry materials, will be a great safety to the store of roots, as frosts do not affect dry substances so much as the damp and moisture, and the coat of earth is much easier penetrated by the frost than the materials now named. In this condition beetroot remains as green food up to May of the succeeding year the earliest green forage crop, and really what forms the first change in the materials that are provided for food. Sprouting of the roots is wholly prevented by the covering in a dry and cool position of the store-heap, and a thoroughly dry condition of the roots when the store is formed. Experience attributes a milky quality to beetroot, and in the raw state it is an agreeable and valuable food for milch cows in the dry weather of the spring, and the juicy roots are of a cooling nature for growing pigs. In the storeyard the use of raw beet is most highly beneficial—indeed, invaluable—and steamed

into mashes with grain meals a very useful food is composed for fattening pigs and poultry, and for milch cows as a change of food. The tops of the beetroot are collected and are used as food for pigs in the storeyard and cattle in the fields, and when well got while green and fresh they are not refused by cows.

Growing with a large proportion of its bulk out of the ground, and barely touching the soil, the plant is wanting in the fecal exudations which characterize turnips and potatoes, which tend to fertilize the land. But the shade over the ground from the leaves of the beet covers a larger extent of ground than the turnip, and fully equals the potato in that respect; and as large succulent leaves are very justly supposed to draw much food from the atmosphere, and the beet plant being very highly endowed in this point, the cultivation of beet may not extract a greater number of the constituents of the plant from the soil than other crops which are similarly formed. The crop, however, demands that all the points of the cultivation of the soil which we have described should be carefully carried out; and if so, a large weight of produce, which is not inferior in feeding value to any other root crop, may be reasonably anticipated—always considering the special circumstance of its use as an article of food which we have alluded to above.

Cabbages.

The cabbage is a strong-growing vegetable plant with large leaves, which at a certain period of growth, in some varieties of the plant, bend inwards over each other, form a very compact series of layers, and a large "head" of great firmness and solidity. The leaves are fibrous, and coarsely veined and indented.

The stem or stalk averages the height of 8 to 12 inches, fibrous, coarse, and coriaceous, with a number of small fibrous rootlets that spread widely in the ground, clustering into bundles of most rampant feeders. The whole plant denotes a body of coarse bulk, requiring large supplies of manure.

The family of the plant comprehends a large number of species and varieties, as turnips, kales, greens, and coleworts, and other esculents of the cruciferous order. The seeds are very abundantly produced and easily gathered. The growth in the matured condition of the largest possible bulk requires a forward condition in the soils under its cultivation, and accordingly the seeds are sown in beds of rich soil in August, on which the young plants grow till autumn, when they are transplanted to form straight rows, which remain over winter till May of the following year, to be finally planted out in the fields. In northern districts the plants remain on the seed-beds without being transplanted, which is done to prevent the shooting into seed stems to which they are liable in the early districts, but which is prevented by the northern colds.

Cabbages require the very best soil that can be obtained, deep, moist, tenacious, in a friable clayey loam. These soils, and those of the next degree in quality, must be ploughed in the early winter by a power of 3 or 4 horses, with a deep furrow of 8 or 9 inches, of a proportionate width to expose as large a surface as possible to the action of the atmospheric influences, and also to produce as fine a tilth as possible for the crop. Being cultivated by two workings, by the middle of May the land is opened into drills of 30 inches in width, and deeply struck for the purpose of the roots finding a fresh earth in which to search for food. The

farmyard dung, in a very moist condition of well-mixed fæces and short straws, unfermented and fresh from the yards of the homestead, is placed in the intervals of the drills in small heaps, from one-horse carts, covering the bottoms, and spread uniformly by hand-forks along the intervals to a depth of 2 to 3 inches. The ridges are split and reversed over the dung with two furrows of the plough going and returning, forming a new ridge of fresh soil, on which, being lightly rolled, the cabbage plants are inserted by hand, dibbled to the depth of the natural mark on the stem from their growth in the seed-bed. They must be pressed firmly into the soil at the distance of one foot apart, or more on good lands, the long fibres of the rootlets having been shortened by cutting. A dibble-hole may be left at the side of each plant for the purpose of holding moisture. The dressing of the roots is done on the plants being drawn from the seed-bed, when they are placed in vessels or tubs holding water, with the roots immersed and the tops floating, in which position they are carried to the field and taken from the tubs as wanted for planting. After a proper interval has passed, the bottoms of the drills are deeply furrowed by the miniature plough, hand-hoed, and scarified, as has been detailed for potatoes and beetroot, unless its condition may require a third application, as both the plant and the land demand the most careful cultivation. The crop is now allowed to grow into maturity, the blanks or failures of any plants being supplied by fresh sets from the seed-bed, so that no deficiencies in the crop may be allowed.

In the late autumn the crop of cabbages is stored on a dry bottom of ground, in longitudinal piles of about 8 feet in width and 4 or 5 feet in the centre height, and

sloped in the sides to a narrow top. The heads of the plants are cut from the stem by hand-sickle, and carried to the store-heap with a gentle handling to prevent putrefaction from bruises, built by hand into the pile in an outer row sloping to the narrow top, and there finished with a single line of heads in the manner of cannon-ball piles. The thatch is then placed on the frame of timber laths, which prevents the thatch from touching the heads, keeps off rains and snows, and admits fresh air, which, with a dry bottom, will preserve the cabbages till June of the year following. The constant supply of green meat is most essential on farms of the class under consideration.

Cabbages in a raw state are a most excellent food for store pigs in the open yard, and leave much refuse from the decayed leaves and stems for the manure heap. The stems are very tough, coriaceous, and lasting, and require to be cut into small pieces in order to decay quickly, to be mixed with moist fæces and the urinary liquids. The outer partially decayed leaves of the heads, at the time of storing the crop, may be useful more or less as food for the store pigs. For milch cows the use of cabbages is equally advantageous; the taste imparted to the milk by the food is prevented by carefully removing every decayed part from the heads when the crop is raised in the fields, at the time of storing, and when used as food. These preventives will nearly remove all objections which prevail as to cabbage giving a taste to milk where milk is used for domestic purposes, and wholly ceases in the present class of farms, which chiefly, if not only, rear calves for the veal. It should, however, be noted, that the taste given to the milk by cabbages has been and is much exaggerated; for, as a rule, this is scarcely perceptible, and indeed

in many cases is wholly absent. For steamed food cabbages have not been rated high, and in the raw state they are more valuable for milking rather than for fattening, which places the root in a secondary position as food used for the twofold purposes here named. The very large and comparative coarseness of bulk shows that a large quantity of manurial constituents will be required by the plants, which are supported by the number of clustered rootlets that penetrate the ground in search of food, and are most rampant feeders. The fact is certain that cabbages require the very best cultivation, in the proper quality of soil and large quantities of rich manure, and, above all, a climate that is not only naturally moist, and rather above the average as regards rainy weather, but with a warm temperature sufficient to banish a hurtful degree of coldness, to develop the plant. On dry and shallow soils, and more especially under dry and arid climates, the cultivation of cabbages of the first quality will be almost hopeless.

Increasing the number of Root Crops for Feeding Purposes.—Extra Crops which may be grown.

It behoves every one interested in the live stock of the farm to try every means by which food can either be increased in yield or economised in consumption. Greatly conducive, we believe, to the latter point, in practice, is the plan or system of having a variety of produce at command for feeding, not only because the evils of total or even partial failure in one crop, which may happen in any season, and often does happen, may be averted by having other crops to fall back upon, as the chances are that all will not be failures (the weather, or soil, or other circumstances suiting one which would not suit another), but because there is a positive gain in feeding through having a variety of foods at command, by which changes in feeding can be

carried out. Further, some roots are better at one season than another. Thus, for example, mangolds are best kept or stored up for some time, not only being anything but economical if used when or shortly after the time of being taken up, but being positively injurious to stock, more especially to lambs and sheep. Hence we should advise the feeder to cultivate as wide a range of roots for winter and spring keep as he can. Of these, in addition to the turnips, mangolds, beets, and cabbages already described, we name and briefly describe the culture of carrots, parsnips, and kohl rabi. First as to

Carrots.—There is an opinion held by some as to the cultivation of this crop which has given rise to many grievous disappointments as to its results both in weight and quality of yield, and that is that any poor if only it be light soil will do for it; some we have heard say even that poor sandy strips on the sea margin or elsewhere will grow excellent crops. While it is true—and the habits of growth will show the reason why it is so—that a light, friable, easily penetrated soil is suitable for the carrot, it is not true that the soil may, or as some put it must, be poor. The opposite of this is the truth—a light, porous, friable, yet to a certain degree withal consolidated or firm soil, well, indeed richly, manured, brings the requisites to success so far as those two elements are concerned. What is known as a sandy loam is the quality of soil best adapted to the carrot. Deep culture is essential, so as to secure a soil into which the roots can easily penetrate; and as the habit of the plant is towards vertical growth, the deeper the cultivated soil the better, so that it may have room to develop itself to its furthest limits. As the carrot draws very largely indeed upon the inorganic or mineral constituents of the soil—that is to say, requires a large amount of these in order to its healthy development—we see another reason to prove the error of supposing that a very poor soil will suit it. The manures, therefore, which ought to be given to the crop should be such as will s pply the wants of the plants in this respect, lime being very heavily drawn from the soil by them—nearly 200 lbs. to every 20 tons per acre of the crop—should form an essential part of this manure, as well as ashes of vegetable matter. There cannot, indeed, be a better manure for the carrot crop than the contents of a well-made compost

heap, to which is added a goodly proportion of the ashes of weeds. There is no better use to which these can be put, and such refuse as woody stalk of plants such as beans, and of tall weeds, as the dock and the thistle dried, with which lime and peat-earth should be mixed, not forgetting salt, of which the crops require a goodly proportion. The manure should be old "short," that is, well rotted, hence our reason for recommending compost heap stuff, the fish "long" strawy manure of the farmyard dung being by no means fitted for the crop. Great care should be taken to incorporate the manure with the soil, so that the plants will receive their fair proportion of manurial matters.

Carrot-seed is of all the seeds of the farm, perhaps, the most difficult to sow, as it is so light, each seed being provided or furnished with a ciliary fringe, so to say, of projecting hair, which renders it a difficult matter to sow it, even with but a very light wind blowing. The best way to overcome this difficulty is to mix it with sand which is slightly damp; this gives weight to the mixture, so that the seeds are not easily blown away, while the hair-like processes are also damped. There are several varieties of the carrot, some having a short thick growth, others long and spindly, while a third possesses both qualities, being thick at the upper part and long-shanked at the lower. This is, perhaps, the best, as it enables the plant to go down to the soil to search for its food constituents, while the manure, which is generally too often kept at the surface, or nearly so, gives nourishment to the upper part. Much, however, depends upon the soil. If rather heavy, the thick and short varieties will be the best. Of garden varieties, the Altrincham Red is a favourite. The Long Orange is preferred by some, although as a rule the red varieties are the sweetest. The White Belgian carrot is said to produce the largest yield.

The carrot, like the beet, is sown drill fashion, either on the flat or on ridges. If the land is very dry, as well as the climate, the first plan is best, if wet and moist the second. The width of the rows may vary from 16 up to 18 or 20 inches and the distance between the plants from 6 to 10 inches. Dibbling is the best way to sow the seed, but the process is tedious and therefore expensive, and is more adapted for garden than for field culture, or for small breadths of farm land. Still, if slow in one, it is quick in another way, inas-

much as the singling, weeding, and after-clearing of the crop is very quickly done. Like all root crops, the carrot requires to be well weeded in the early stages of its growth; indeed of all these it is the one to which this process is so essential, that if it be not carried out, and the weeds are allowed to choke up the plants, these never get over the evil done them, no matter how careful the cultivation may afterwards be. About five pounds of seed to the acre is a good allowance.

The Parsnip.—The next crop which may be cultivated, in order to keep up the variety we have recommended, is the parsnip. It cannot be said to be a farm crop much cultivated, any more than could, at one time, be said of the carrot; still, as affording a change of food, and as, moreover, it possesses many valuable qualities, a small portion of it may form part of the farm cropping with considerable advantage. One good quality it possesses, and that is it is capable of standing very severe frosts; we have indeed had them in the ground all the winter and found them good feeding stuff in the spring. Like the carrot, the parsnip requires a soil well and deeply cultivated to enable it to send its roots deep into the soil; like it, also, it requires a good supply of manure.

The parsnip is next in feeding value as a feeding crop to the carrot. Some, indeed, rank it higher, especially for dairy cows, which are particularly fond of it, and as adding much to the yield as well as to the quality of the milk, and the consequent richness of the resultant butter and cheese. The best way to give the roots to the cows as well as to horses, which thrive upon and are fond of them, as well almost as they do upon and are of carrots, is to wash and clean them, then slice them by machine, and mix them well up with finely cut straw of one kind or another—oat and pea straw are the best—with a little meal or artificial food. Pigs also are very fond of parsnips. The way they relish them best, and best thrive upon them, is to well wash and cook them as a mash mixed with other materials. The soil best adapted for the parsnip is a calcareous or chalky one; it is found indeed growing wild in some districts in such soils. But it will thrive upon almost any kind of soil, so that it be deeply stirred to enable the roots to descend far into it, which they will do to a remarkable extent under favourable

circumstances, lengths of from three to five feet not being uncommon. A fine friable soil moreover encourages their lateral or rather diametrical growth, so that they increase proportionally in thickness. The soil should be in good heart, rich in manurial constituents, but where farmyard dung is designed to be employed, it is better to apply it to the preceding crop, as if applied to the crop itself it is apt to interfere with the development of the rootlets and roots, causing an abnormal or crooked growth, which greatly injures the development of the root, as well as injuring its quality, rendering it tough and woody. When manure is applied to the crop, it ought to be very old, ripe, and "short," but the better manure to use is that from the compost heap, which, if well managed, is in a pulverized condition, which will mix well with the soil, and offer no obstruction to the descending roots. The earlier the seed is sown in spring the better; some indeed prefer to sow it in the preceding autumn. This secures a larger yield, if means be taken to keep the plants free from weeds. The plants are very hardy, and may be left out, as we have often left them out, to all rigours of the severest winter, and they have seemed little if any the worse for the exposure. The culture is almost identical in every detail with that of the carrot, described in preceding paragraph.

Kohl Rabi.—This is a root of comparatively recent introduction, and possesses so many valuable qualities that it is a matter of some surprise that it has not been more largely cultivated. Those who have adopted it as one of their sources of root supply speak of it in high terms of praise—excelling in many respects the universal root, the Swedish turnip. The kohl rabi is particularly well adapted to localities which are subjected to severe and long-sustained droughts, as it can stand the effects of these for a long period without being much, if indeed any, deteriorated; and, on the other hand, it is equally good for exposure to severe frosts. Another advantage it possesses is that it can be grown from plants in a seed-bed, and transplanted from thence to the field; and so well adapted is its habit of growth to this, that good plants take rapidly to the soil and receive so little "backing" from the change, that the crop of transplanted plants is not seldom found to be better than a crop grown from seed sown in the drills. Hence some growers

of the root prefer the system of cultivating it by transplanting from a seed-bed. The root can thus be made to serve a very useful purpose; for by the simple, inexpensive, and not very troublesome making of a seed-bed for raising young plants, blanks which may occur in other root-crop drills, as in the Swede drills, for example, may be filled up with profit—more at least, by a long way, than if the land is left bare, which is the least profitable of all ways of using a soil; or should the swede crop be a total—or almost so—failure, then the plants of the kohl rabi so providently provided will enable a portion of the land, at least, to be laid out with kohl rabi plants, which will to an almost certainty yield a fair supply of roots. Further, the last advantage to be named here which the root possesses is, that it seems peculiarly suitable for dairy stock, who are very fond of it, and in nutritious or feeding principles it is superior to Swedish turnips, and that to a very considerable extent. Lastly—and this to dairykeepers is a point of no small importance—the root does not impart any unpleasant flavour to the milk, and, by consequence, to the butter made from it—one of the great disadvantages produced by the Swede turnip when used under certain circumstances. Pigs also are fond of, and thrive upon, kohl rabi; so that there are abundant reasons to induce the farmer to give it at least a trial or two, should he not have already done so.

From what has been above said it will be seen that the crop as a field one may be grown in one of two or in both ways—either the seed may be sown in drills, where the crop is to be grown, or plants may be raised in a seed-bed and transplanted to the land at the proper seasons. We shall, before describing these two methods, give a few remarks on the preparation of the land common to both systems. Comparatively little, however, requires to be said on this, inasmuch as the preparation of the soil, as well as the after culture of the plants or roots, resemble very closely in their details those already explained for the turnip crop. The soil which suits the turnip will suit the kohl rabi roots; it must be brought to as fine a tilth as possible, to ensure which the same methods of working as explained for the turnip may be carried out for this crop. Still it is noteworthy that where in some districts the soil is too close and heavy for the most successful results in turnip culture to be attained, the kohl

rabi may be grown, and grown with profit; in fact it is this class of soil which is that best adapted for the root. The kohl rabi is greedy for manure, as heavy dressings as 25 to 28, and even 30 tons of farmyard manure per acre being given to it. For kohl rabi, as for all plants of the Brassica or cabbage tribe, salt is a most useful, nay invaluable, ingredient in the manure applied to it, and of this from two and a half cwt. per acre may be used. Some successful cultivators of the root find the additional cost of double this weight of superphosphate of lime well repaid in the extra yield of roots obtained. As in the turnip, so in this crop, the ultimate or final process in the preparation of the soil should have for its object the keeping in of its moisture, so as to insure a good start for the seed, if that be sown in the first instance.

Coming now to the culture of the crops, we take up the system of transplanting first. The seed-bed should be made in some sheltered spot in the garden or field, but in either case the soil must be of the best quality—a rich loam, workable to a finely pulverized and open condition, being the best. To insure this condition, it is advisable to lay out the seed-bed in early autumn in high ridges or drills, so as to allow the frosts and atmospheric influences to act upon the soil for as long a period as possible. Some prefer to manure the bed at this season, others in the spring. If the manure (farmyard) be fresh and long it will best be put in the soil in autumn, if ripe and short in the spring; but for a seed-bed, in fact, the shorter the manure used, or the more nearly it appoaches the friable condition of artificial manures, in which it can be well worked into and mixed thoroughly with the soil, the better. All long straws, &c., greatly interfere, not only with the proper development of the plants, but with the after-stirring of the soil and cleaning it of weeds between and amongst them. This applies to seed-beds for all plants, the object being to have to each individual plant a regularly formed, well-shaped root with abundance of rootlets, those giving in all cases the best plants or roots when transplanted to their final place of growth. The seed-bed being well prepared, the seed—at the rate of half a pound or thereby for each acre to be planted in the field—should be sown the first week of March in drills, not broadcast; the quantity of seed required may be less than the above, as the drill

system enables the soil to be stirred between the weeds taken out from amongst the plants in a way much more efficient than when the seed is sown broadcast. The distance behind the rows or drills need not exceed nine, but seven inches will suffice, if a small tool or specially made hoe be used; and it will be worth while to have a tool of this kind made, as it will be useful for many crops in the garden, as for onions, &c. &c. As a rule, hoeing tools, as usually made, are too large for seed-beds. The soil after the seed is put into the bed should not be, as it usually is, raked and combed, so to say, till it is as small and fine on the surface as it can be made. This is labour fairly thrown away; worse than this, for it is in one sense mischievous; rough ground leaves protuberances which shelter the young plants from the frosts of the early spring months, and as the season advances all the roughness will disappear under the hoeing, stirring, cleaning and weeding of the soil and plants, which cannot be too frequently and carefully done all the time the plants occupy the seed-bed. The stronger the plants there, the better the ultimate roots in the fields. As successional crops of the root coming to maturity at different periods will be found useful in some cases, a succession of seed-bed sowings should therefore be made, say, early in March for transplanting in May; in April, for transplanting in June; and in June, for transplanting the end of July or first week of August.

The plants will be ready, under the circumstances of ordinarily favourable months, the first or second week of May, when they may be taken up and carried to the fields, the soil of which has been prepared as described. The plants should be sown in rows 24 to 30 inches apart, and in the "flat" or in "drills," according to the nature of the soil and climate: if very dry, the flat; if moist or wet, the drill system should be adopted. The distance between the plants in the rows or drills will or should be decreased in the case of the later transplantings of successional crops: thus for the second transplant, 16 inches; for the third, 12; while the distance between the first plants in the drills or rows in all cases should not exceed 18, nor be less than 17 inches apart. Although the kohl rabi, as before stated, is so admirably adapted for transplanting, that comparatively few in the field rows or drills

will "miss striking," still prudence demands that such a contingency should be provided for, by having plants in the seed-bed to fall back upon; these, if not used, will in all probability be found valuable to fill up blanks in other crops more given to missing—on which filling up, it may here be remarked, that it is surprising it is not more followed out than it is. What can be more opposed to the main object of farming, which is to make all the land productive (and that as highly as possible), than the systsm of leaving yards upon yards of drilled root crop land to be all the season unoccupied, simply because the seed has failed, or the plants have been fly-devoured, or otherwise destroyed or lost? In taking up the plants from the seed-bed, care should be exercised in selecting the best and strongest, putting them neatly in a basket, with all the roots lying in one direction. This will be easily done at the time, and will greatly facilitate the transplanting in the field. The plants should be dibbled into the soil as nearly to the same depth as they were in the seed-bed, and the dibbling should be so carefully done that each plant will have a firm hold of the soil, this being rammed well up to the root by the dibbler. This can be done just as quickly as the careless way in which the root is left in the centre of the dibble hole with very little soil near it, which is the reason why so many transplanted plants fail to take to the ground.

In sowing the seed in the drills or in rows on the flat system, the month of May is the usual month for the work to be done. Some have two sowings, one a little earlier than the first, and from the thinnings of the first sown drills plants will be got in sufficient numbers from one acre to transplant four or five acres, thus gaining the advantages of an early drilled crop and a later transplanted one. In thinning out it is said to be a good plan to bunch the plants out, leaving spaces of soil twelve inches long between the bunches. The bunches are left after this for ten or twelve days, during which the soil is well stirred, and then the drills are gone over a second time, and the bunches thinned out, the one that is left in being the strongest and best plant.

We have said in a preceding paragraph that on nearly every farm, even in those which are well managed, there are odd plots here and there of unprofitable land. These vary in extent

from a few rods up to even as much as half an acre. These, although they do not come under the category of or are not classed as true waste lands, are still thoroughly so, and are allowed to remain from year to year so, simply because the farmer may consider them too small to repay the cost of reclaiming them, or that they are so poor that they could never be made to bear crops of any kind which would repay that of seeding and reaping, or gathering in. But although this may be the opinion of the farmer, it is often erroneous, or at least the fact is never thought of, that there are some crops peculiarly suited to such lands, which, while they produce largely even on them, cost but little in their cultivation. We have shown in another paragraph, for example, that a very useful forage crop—highly valuable indeed, on more accounts than one—may be grown upon such plots, namely gorse. We have now to draw attention to a root crop equally valuable in its way, and peculiarly well adapted for such wild waste plots. This is the "Jerusalem artichoke," rarely, if ever, grown in this country as a farm crop, but one which has been largely introduced abroad. All live stock are, as a rule, fond of it, and in the case of dairy cows it seems to have an influence upon their milking capabilities, increasing the yield. If an objection be made that it imparts a flavour to the milk, we are not aware that this fault has ever been found with it; but if it be so that it has this effect, it cannot be worse than the flavour which Swedish turnips give to the milk, for the flavour of the artichoke is not only much more mild, but it is more pleasant; and, in any case, the cure or prevention of the evil open in the case of the Swedes is equally so in that of the artichoke—namely, never giving the roots immediately before milking, but always after it, and that immediately, so that the longest possible period before the next milking will be secured.

The Jerusalem artichoke is grown in the same way as potatoes, from "sets," or from the whole tuber; and the cultivation is the same, only that so readily does the artichoke take to the soil, and so largely does it yield, even though that should be of the poorest, and little or no manure be given to it, that the tubers may be stuck in here and there into the soil, which may have had merely a rough digging or grubbing given to it previously. But if the proper preparation of the land—potato-culture fashion—be not grudged,

it will only, or need only, be required or given in the first instance, for no after seeding is required, the tubers or parts of tubers left in the soil after the main crop is taken up being sufficient to seed the soil year after year, so rapidly does it spread. This rapidity, indeed, is, perhaps, the only bad point in the crop, for so long as there is land for it to occupy, it will occupy it gradually, taking and retaining the possession of it, for once in the soil, there is no "evicting" it. But as it will only be grown in such plots as we have named, this peculiarity may be overlooked. But while a liberal producer, even when little labour be given to the crop, its value, we need scarcely say, will be increased, and a very large produce obtained if the soil get a turning over with the spade or the grubber and the plough, with a slight addition of manure, the surface being then finished off by a "bout" of the harrow. Those who thus utilise such waste plots as we have mentioned will have no reason to regret having done so, and thus give a practical exemplification of "making the most of everything," and turning even what is looked upon as useless to useful account.

Before concluding this note, we deem it right to refer to two points alluded to in the text. The first of these is where the author treats of the storing up of *cabbages*, and describes the method which he recommends. While this method is a good one, and specially so as to the covering of the heap by means of a lath frame-work—decidedly preferable to the covering of soil generally employed—it is nevertheless worthy of note, that where it is more convenient to have the crop of cabbages left in the field, or at least a portion of it, to be taken up as required, they may be left out without any danger of spoiling being incurred; at least this is reduced to a minimum, as, contrary to general opinion, the cabbage—and more especially the drumhead variety, usually cultivated for farm stock food—is a hardy plant, capable of withstanding even very severe frosts. One has only to draw to remembrance the fact, so singularly overlooked, that cabbage sprouts in gardens are many of them left out all winter, and yet in many cases where left, up to even a period far on in spring, they are in such good condition that they form an excellent and most palatable food. In the case of the field-cabbage the outer leaves generally decay, and this has doubtless led to the popular notion that the whole mass

is equally affected; but if these outer leaves be removed, the cabbages will be found perfectly fresh and sweet; these decayed leaves, in fact, serve as protectors to the inner mass. Of course, as in all such cases, there are exceptions to the rule, and cabbages thoroughly decayed will now and then be met with; but these are the result of abnormal causes. The second point alluded to in the text is the taste or flavour which cabbages are said by the author to impart to the milk when eaten by milch cows; but this effect is greatly exaggerated, and if all the decayed leaves be stripped off before the cabbages be given to the cows, they will be found practically to impart little flavour to the milk, very often none whatever. But if it should be found that they do, then by simply giving them to the cows after they have been milked, and not, as is usually the case, as is also done with Swedish turnips, before milking them, no flavour will be imparted to the next milk drawn from them. This, while it is the simplest, is the most effectual way of preventing any roots giving a flavour to the milk, and obviates all necessity to employ one or other of the numerous methods in use, which are all more or less troublesome to carry out.

CHAPTER III.

GRAINS—BEANS—PEASE.

COMPRISED in the common kinds of wheat, barley, oats, beans and pease will be grown on the farms now under consideration, and always with a special view to the articles of food required for the live stock reared and fed on them. Wheat, not being yet introduced—or only when its price is at or about a penny a pound—into the list of these foods, will be grown, as a rule, on these suburban farms only to an extent sufficient for the supply of the household, and on the lands fallowed with root crops, as also such barley as may be required. Both of these cereals are grown at the rate of two bushels to an acre, the seeds of wheat being "steeped" to prevent smut, the light pickles skinned off, and the sound portion encrusted with lime, and to be dried before sowing. One furrow of ploughing receives the seed sown in October, and that of barley in April, and both covered by the harrow. Soon after the barley is sown, a broadcast sowing machine or grass-seed blower is used to deposit the grass seeds on the rolled surface, which are covered by the light harrows.

For a crop of hay and one year's pasture sow per acre the following mixture :—

1 bushel of best perennial rye-grass,
8 lbs. of red clover,
4 lbs. of white clover,
4 lbs. of meadow fescue.

The wheat tilth is harrowed with a double turn of the common harrows, and rolled across with a one-ton cast-iron roller. The barley tilth should be sown with grass seeds before the braird is grown so as to be hurt by the rolling and harrowing, which last operation is to be lightly done, and after the rolling, to prevent any crust of the surface on calcareous soils being formed by the action of warm showers and hot sunny days. These grains may be sown in broadcast where the least expense, without the trouble of drilling, is an object. The tall weeds, if any, may be pulled by hand before the full growth of the plants prevents any intrusion of the labourers. When ripe the crops are cut by hand-sickle, by the scythe, or by the reaping-machine, tied into sheaves, and placed into ricks in the rickyard, and properly thatched.

The quantity of wheat grown on these farms need not be very large; a few acres will suffice, and in some cases it may be even wholly omitted. But barley is a standard crop, and is in our opinion—although other feeders hold a different view as to its value, some indeed maintaining it to be injurious, why, they do not, as a rule, say—choice food for pigs in the raw state, and chiefly in meal for soups for young pigs, and for fattening hogs in a mixed consistence with steamed roots, as potatoes and turnips. Hence that grain will occupy the whole extent of the fallowed lands which grow the root crops.

Oats

will occupy about thirty acres yearly of the extent of farms now being treated of, on the ley of one year of pasture grass. The seeds are sown in March on a stale furrow of the land, ploughing in January, at the rate

of five bushels to an acre, and covered with three double turns of harrowing, the second across the ploughing, and the third lengthwise, which finishes the operations of seeding. A heavy rolling may be done across the land before the braird can receive damage from the process. All small weeds are cut by weed-hooks at an early period, and any tall weeds that may afterwards appear are pulled by hand when access is obtained by any opening in the crop, before being left to mature. The ripe crop is cut by hand-sickle, mown by the scythe or by the reaping-machine, tied into sheaves, and built into thatched ricks at the homestead, and threshed when required.

Oats are used chiefly as the dry hard food of work, horses, as affording sustaining food in a small bulk suited to their small stomachs. As dry meal feeds are good for finishing off the fattened hogs, in order to whiten the flesh and to give firmness to it and to the muscular frame, oats will be found very good for this purpose, as also for making warm soups for brood-sows and young pigs, and for mixing with steamed roots in mashes for store pigs, and the first stages of their fattening when put up for this. In a dry mealy condition, oats, when mixed with steamed potatoes, are excellent for poultry, while there is scarcely any food they relish better than oats in their natural condition, thrown down for them to peck at in their first morning, or at least their last evening, meal.

Vetches

of the spring variety will occupy about 20 acres on the farm, and sown by hand at the rate of 4 bushels an acre, with a small mixture of oats or barley, or, what is better, rye, on the land which has been occupied by

the two years' grass, and covered by three double turns of the harrow, lengthwise and across, and heavily rolled to make a level surface for the scythe in mowing the forage crop. Three sowings, at intervals of three weeks from the earliest that the weather permits, before or in the beginning of March, will afford a succession of fresh green-meat that is most desirable for the animals. When circumstances permit, a portion may be permitted to ripen to be made into hay, and to afford a supply of seed. A very superior food will thus be provided for work-horses and for store pigs, the seeds being very concentrated feeding material, while the hay will be found fairly nutritious. Legumes must be very thickly seeded on the ground in order to form, by the tendrils joining together, a close shade of leaves, under which the weeds are wholly destroyed. The surface of the ground is mellowed into a fine tilth by the retention of moisture and the exclusion of sunlight, heat, and consequent drought. This object must be secured to get at once a good crop of the plants and the improvement of the land.

In early climates or mild winter seasons, the winter variety of the vetch sown on stubbles and leys in autumn on good soil, afford an early green-meat in spring. Winter rye and barley are sown also with the vetches—generally the latter—these serve not only as a support for the vetches, but the first two plants form an excellent forage food. The chief purpose of the crop is for sheep, ewes and lambs, and as sheep are not kept on the farms now being detailed, the plant does not form a primary consideration, but still under the circumstances of mild and early climates, the winter vetch to a moderate extent, will constitute a very useful introduction into the spring green-meat of the farm.

BEANS

may occupy about 15 acres on the farm, and may be sown by hand at the rate of three bushels to one acre on the ley furrows of the two years grass, and covered by harrowing and rolling as has been detailed in the case of other spring-sown crops. Of these the bean requires to be the earliest sown. The very small extent of the bean lands in the present case hardly requires the use of the drill machine. They should therefore if sown by hand be sown thickly, so as produce a heavy growth of the plants to cover the ground closely with a leafy shade, which with even partial hand-hoeing and the pulling and cutting of weeds will produce a nearly similar effect to the open drilling of the horse and hand hoe. When ripe, the crop of beans is cut by hand-sickle, tied into sheaves with straw ropes or tarred twine, and built into thatched ricks.

Beans, with a small quantity of oats, are most valuable food for horses, as the tannin contained in the pericarp of the seeds serves to keep the flesh and the muscles firm. The meal of beans is useful in soups for brood-sows and young pigs, and for being mixed with steamed roots as fattening food for the best hogs, that derive much benefit during the last month of fattening from a small portion of unbroken beans which whiten and consolidate the flesh; and even when the seeds are seen to pass through the intestinal processes in an unbroken state, the benefit is still, to some extent at least, bestowed on the animals, as the nutriment even then seems to pass from the seed to the animal by an unknown process. For some purposes the grinding of the seeds seems of doubtful utility.

Pease

will occupy about 15 acres of the farm, sown by hand in March on a single working of the previous winter's ploughing of the ley of two years grass, and at the rate of three to four bushels to an acre. The seed is covered by three double turns of the harrow, and the land is rolled before the young shoots can be hurt by the weight of the roller. Tall weeds are cut or pulled by hand at an early stage of the growth of the plants, which admit the drilling in rows, the intervals of which are soon covered by the procumbent stems of foliage. The ripe crop is cut by hand-sickle, rolled into dried bundles that are tied by a rope of the haulm, and placed underneath a covering in the rickyard. The thick seeding of pease on the ground is most essential to the produce and to the improvement of the land after the crop is removed. The plants must be numerous in order that the tendrils will meet and intertwine with each other, to produce a close mass of foliage to cover the ground, under which all weeds are completely destroyed, insect and minute life is killed and putrefied, and the surface of the ground is mellowed and mollified by the retention of moisture and by protection of the land from drought and waste by exposure. A thin straggling crop of pease is bad, and foul land is the result, for if not occupied by plants it will be covered with weeds: the open surfaces encourage all kinds of worthless vegetation which no hoe or scarifier can reach. When such cases occur, the best thing to do is to plough up the crop and supply its place with one of turnips of a quick growing variety. Foul crops of pease and beans are indicative of a very deplorable management of the land. Both plants

delight in the best soil in early climates, and the crops are very uncertain when one or other of these is wanted. The plants like much moisture, but are easily damaged by too much wet. They frequently fail under an arid temperature, and on thin dry soils the full crop is not usually obtained. In farms at present under consideration a good soil in high cultivation will secure the full vegetation to which we have alluded.

Pease form a most useful food for pigs; the meal is good in soups or mashes for young pigs and for farrowing sows, and for being mixed with steamed roots in a thick mash for fattening pigs and poultry, where a dry mealy condition is required. The raw grains afford a dry food for fattening hogs in the last stage of being finished, being given with small portions of meal daily, sufficient only to consolidate and whiten the flesh, and, when well harvested, the straw or haulm of pease forms a most excellent food for work-horses, and which is not exceeded in value by any kind or quality of hay.

CHAPTER IV.

THE LIVE STOCK OF THE FARM.

Horses.

The horses which are required for the purpose of performing the work on the farms now under consideration must be strong and active with a placid temper. The work consists chiefly in daily repetitions of the same labour rather than the heavy occasional work of ordinary farms. For this purpose heavy carcasses and unwieldy bulks are unfitted and must be rejected, as their step is slow, and a huge body requires a large quantity of food for its support. The horse for farmwork should be rather above than below the medium height, high and thin in the withers, deep in the shoulder, and wide in the chest, showing a sugar-loaf formation, the chest the base, and the narrow point of the shoulder the apex; neck thin and long to the ears; face wide at the middle and gradually tapering to the muzzle to broad in the nostrils; eye quick, and with a placid calmness; ears agile and active; the barrel round and cylindrical, rising from the fore end to the flank, which is light and prominent; the hind quarters deep in bone and muscle; pasterns short, and feet sound and of a medium size. The choice colour of the animal black, or with a white star and stripe in the face, hind legs white to the pastern joint, but no more of that colour, which always denotes a

delicacy of constitution. The dark brown colour has long prevailed and yet exists as a mark of good constitution and well-formed animals, while the bay coloured bodies with black legs and tail are indicative of a superior breeding, and are much admired by many. These colours, with a corresponding amount of the other qualities, are found in animals at most fairs in the kingdom in a greater or less degree of value, and as there are always a fair number of animals, their fitness to be employed in the undertakings that are now under notice may be selected with judgment.

In order to obtain the most highly useful animals, the breeding must be done on the farms, and the rearing performed under much care and judgment of the growth of animals. The nearer that mares breed once in two years the progeny is more robust and healthy, and must be kept in nearly total idleness for the sole purpose of bearing young. A farm horse is merely a racer enlarged, so as to have the necessary strength, and the body in a bulk that befits the employment, with a hardihood to withstand the changes and vicissitudes of a life that is much exposed to heats and colds of the outdoor employment. In order to impart a refinement of organization to a bulk of some coarseness, and to combine spirit and activity with strength and motive power, a handsome female must be selected from the animals of the locality, of a choice colour and an adequate strength of flesh, bone, and muscle, as neat a form as possible, and corresponding with the main object in view, as above described. The male used for breeding should be a strong-boned animal three-fourths thoroughbred, powerful in action, and handsome in figure. The progeny will inherit the qualities in good combination, the spirit and activity of the male, with the robust

constitution and strength of the female in the bone and muscle. The mode of breeding now recommended will provide the best qualities of the farm horse with spirit and power always above the average of the work to be performed, and in many cases will produce animals fitted for the hunting field, that will carry weight and go often to a distance beyond those of the most refined purity of blood. Another cross with a thorough bred male might wholly serve the use of the hunting field; but a single cross of good blood and a common breed will be adapted to the farm.

Setting the question of fine blood aside, any farmer may have a breed of all animals as his own, by carefully selecting for the purpose of propagation the best formed animals, and by bearing in mind the principal, that "like produces like." Many of the horses to be seen in a farm are anything but complimentary to the farmer: the improvement of the breed rests on the single and simple principle now stated, requiring no foolish expense nor inconvenience, but merely the exercise of judgment, observation and care.

Cattle.

Of these, cows are reared and kept for almost the sole purpose of rearing veal calves, besides a few heifers to supply the place of old animals, and a few as store cattle to assist in reducing the straws into manure in the dung-yards. The milk farms, being in connection with the arable lands now mentioned, will create a large demand for young calves, as the milk is there wholly used for sale. The cows producing this will be selected to possess the milking quality as the chief property, but not very highly as on the milk farms where milk forms the only article, for all the fattening quality must be present

to a very considerable degree in order to the formation of real flesh in the young animals. Good milking cows and heifers likely to be such can be easily procured from the country markets and of a uniform colour as much as possible—a cross with the short-horn bull will impart the fattening property, which may be continued by using the same plan, and breeding from the improved animal, which would much reduce the desired propensity for milking. Horned cows are better milkers than polled ones, and more inclined to fecundity; a cross of the two breeds would produce a motley appearance in the progeny, and a uniform condition of size and colour is very agreeable to the eye. The purpose, however, for which the cows are bred must be the first consideration; it is not always the finest-looking cows which produce the best milk or the greatest yield of it.

The making of butter and cheese may be partially introduced into the practice of these farms, in order to somewhat vary the routine of practice, as the articles are surburban in their nature, though they may be carried from a distance, and a portion must always be provided for domestic use. But no fattened cattle are reared, nor any animals pushed into the advanced store condition, which would destroy the chief object of rearing veal calves, pigs and poultry, of which the breeds must be of the best, and the management of which such as to produce the highest excellence in the resulting marketable commodities.

Pigs

are bred and fattened to produce a regular supply of sucking pigs, fresh pork, and pork for hams of the small medium size, and flitches of bacon. These are best attained by using animals of the medium size,

or two distinct breeds may be kept, one to produce the articles of small bulks and one those of the larger size and weight. Either method of producing the articles of sale above named will suit the farms at present under consideration. The breed of swine must be white in colour, with a sleek laying coat of strong bristles to denote a robust constitution, which is a most essential point, and the meat being dressed for use with the skin unremoved, the white colour is more pleasing on the table than that of black breeds.

Poultry

are produced in abundance on the farms for the production of eggs and flesh, and are reared, as the hen, the duck, goose, and turkey. The prodigious importation of eggs from abroad is a very sufficient reason for rearing poultry to a large extent, and poultry is universally acceptable as table food. The small bulk of the birds is a matter of comparatively small consideration, for their value is very justly, in many cases, much beyond the common estimation, and as flesh producers no attention can be more advantageously bestowed than on the poultry of the farmyard. The hens most useful are those of the Dorking breed. The birds of this breed have heavy carcasses and good quality of flesh; their laying is good (see last Section), in warm localities especially. In northern districts the black bodies, with red neck and wings, are preferable, to withstand the influence of rains and colds. The russet brown and grey colours are much esteemed, but bulk of flesh and laying of eggs are seldom found together. Climate has much effect on poultry, as the cock and hen, and must, therefore, influence the selection.

Ducks

are reckoned best if of the grey colours. There are many varieties, as nearly black, wholly white, or spotted, showing little uniformity of colour. The bird is less valued than the cock and hen, the eggs being strong in the taste and flavour, and the flesh black and tough. Still their use is considerable.

Geese

are most generally white or spotted in colour, with a flesh of strong texture, but much relished, as it is savoury. The rearing and fattening of geese requires considerable attention, but less than that demanded by

Turkeys,

which are either wholly black or altogether white in colour, with variegated specimens of each colour. The eggs are not used, but the flesh is highly esteemed, although naturally it is strong tasted and fibrous, and thus but little relished as food by epicures. The white colour in this class of poultry is preferable, as the skin is not removed, and that colour is most agreeable on the table.

CHAPTER V.

IMPLEMENTS AND MACHINES.

THESE must all be of the highest class, both as regards design and construction, and specially adapted to the work to be done on the farm—the latter quality being ever present, and not for one moment to be lost sight of. A steam-engine for threshing grains and cutting chaffs, of the power of 8 or 10 horses, must be erected, with the suitable accommodation to be afterwards described, and in close contiguity to the ricks of grain, which will be best if placed under a covering of zinc or corrugated iron, supported by cast-iron pillars. The minor articles of barn utensils, as shovels, forks, rakes, and sacks, and other small tools, are well known, and must be provided of the required quality and number, and of the proper construction, and be carefully kept in repair and set aside in a convenient and dry place when done with. The horses are arranged in pairs, with a driver to each pair or team, and to which he devotes his sole attention. (See the volume in this series on the Labour of the Farm and the Economy of the Farm-house and Cottage.) An iron swing plough, of the most approved form and construction, is allotted to each ploughman, with 2 one-horse carts. The one-horse cart is indispensable in turnip-farming, for the purpose of ensuring quick movements with a light weight, with little damage to the drilled lands, and in being conve-

nient for the frequently recurring jobs of the farm. On the other hand, cases may occur where the draught of 2 horses will be most economical; for these occasions, a light four-wheel waggon, for 2 or 4 horses, should be provided in reserve. The harrows are made of light iron in a zigzag form, which permits a straightforward draught by a long bar in front attached to the harrows. This zigzag structure of the harrows is a very considerable improvement on the old form. A light iron small or miniature plough, drawn by 1 horse, is useful to cultivate the intervals of all root crops grown in drills, with two or more ploughings, and a light scuffler with cutting side knives and a bottom sock moves and pulverizes the earth that has been placed in the intervals of the drills by the plough, fallowing the soil, and destroying all weeds, with the after use of the hand-hoe. The plough, with 2 mould-boards, can be formed from the knived scuffler by removing the knives or tines and fixing on the mould-boards in their place; and this implement being drawn by 2 horses walking in a drill apart, moves the intervening hollow with the mould boards, placing the soil closely to the roots of potato plants. This implement, being purposely constructed with the winged knives or tines, is used for opening and closing the drills of root crops, and on the finest loamy and sandy soils and alluvial earths its work is very satisfactory. But on the stiff bottoms of clayey earths and cloddy loams the two-winged share fails to penetrate the land, to raise fresh earth, to cover the dung, and to receive the turnip seed, very essential to the safety of the plant. The sole of the mould-boards prevents the plough from working downwards by resting on the surface of the ground, and the soil that is pushed over the dung as a covering, and to receive the turnip

seed, is only the dried surface of the land in clods, and the parched tilth. The swing plough, with one share or wing on one side, having a narrow point, penetrates the ground to a moderate depth, and raises a portion of soil from the point of the share, and by throwing this fresh earth over the dung places the turnip seed in a moist soil, which in many cases constitutes the whole safety of the turnip crop, especially in dry seasons. From this point of view there is a very apparent and most decisive superiority in the swing plough.

Drilling of grains we do not recommend on these farms. The cultivation of root crops prepares it for the grains and grass by its being thoroughly worked and manured, and by being horse and hand hoed during comparatively long periods and at the proper season; and if these operations are properly done, the land requires no further treatment except to sow the seeds, and all weeds are or should be destroyed. The drilling of grains, which some maintain should only be done on favourable soils and under genial climates, is objected to because the plants soon rise into a growth that stops any effectual use of the cleaning implements in the narrow intervals; the land can receive no benefit from horse and hand hoeings on the winter-hardened surface, which is not moved but only scratched by the operations. The early and short season during which any work can be done on the lands thus, we believe, effectually prohibits any general benefit from the practice of drilling.

CHAPTER VI.

OUTLYING APPLIANCES OF THE FARM—ROADS—FENCES —GATES, ETC.

ROADS, fences, and gates on well-cultivated lands, and more chiefly on those that are appropriated to our special purpose, and consequently more open to inspection and examination as models of an advanced practice, constitute a portion of the farm that is important to be properly attended to. Roads should be directed over the farm in the quickest lines of convenience to the main road or roads that intersect, or are adjacent to, the lands under cultivation. Every field must have an opening upon a road, obviating the necessity to pass through, or to enter into another field, and each road must lead into a principal road. A farm road must be 20 to 24 feet in width from fence to fence, in 12 feet of roadway and 10 feet in two side paths. The roadway, or upper surface, should be 8 to 12 inches in depth of hard stones, broken to the size of a hen's egg, in a stratum lying on a dry bottom of grassy turf, the thicker matted the better, or on dry earths and gravels, or any dry and gross materials in a moderate size or bulk, and must be dry underneath. A mixture of gravelly or dry clay earth is spread over the upper surface of the road, to fill the cavities and to bind and cement the broken stones together. The inequalities, which in time will arise from the traffic, must be care-

fully filled up and levelled. For this purpose the gatherings of stones from grass lands must be carefully preserved and broken into the proper size, and laid on the road when required to fill the inequalities, and rolled with the heaviest roller available.

Fences

will be made chiefly of thorn hedges, stone walls, and by posts and rails of rough or sawn timber. Stone walls are fences the quickest in being formed, the most durable, and afford the most shelter in exposed situations. The materials are found ready for use only in rocky countries, and in the diluvial detritus of torn and transported beds of stone; in these places they are easily available and cheap, and the fences made of them are durable, and raised with comparative ease and economy. In alluvial countries, and in all places that are removed from the locality of the primitive rocks, the use of stone walls as fences on the farm is not available.

Thorn hedges require several years to complete their growth, much troublesome attention in the planting and management, and great care to maintain them in good order. The strongest quick-sets in the nursery are cut to the proper lengths with a bud eye at each end to form the root and the vertical growth, and placed at the distance of four inches from each other on the slope of a turf soil or of compact earth in a straight line which takes the direction of the intended fence. In front of the fence a cavity is dug for earth to lay over the quick-sets firmly and finished off loosely, forming a rough mound to receive rains and transmit moisture to the plants beneath. On wet lands a ditch is dug in front and a higher mound is formed with the excavation at the back of the fence. A fence of sawn stakes and

rails is placed in front of the fence and on the back of the mound of earth to protect the quick-set shoots from trespass, and must be kept in good order till the hedge is grown to a height and strength sufficient to resist the attacks of cattle, &c. In this position the thorns rise and form a line of prickly timber or strong shrubs with an unchecked growth, except by lopping any extra height of the shoots in order to produce as level a height as possible, and the same in the front to obtain a straightness of fence with a thick growth of timber at the lower part. The growths are otherwise wholly unchecked till a strong line of the thorny tree has been reached, when the intended fence may be cut and formed into the shape that is desired. The cutting, slashing, and mangling of thorns during the younger growth checks the vigorous growth by forming a cluster of branches at the incisions, and protracts the period of maturity. During the first years of its growth the gaps must be carefully filled with young sets, and any weak places of growth must be strengthened by intertwining over the vacancy the side branches of the adjoining stems. In this way a close uniform fence will be obtained.

Fences of posts and rails are only adapted for warm low-lying situations, are expensive, and do not afford a shelter, and are wholly unfit for high and cold districts. In some cases of an abundance of timber of any coarse quality, and in warm localities, the use of such fences will be advisable.

Gates,

with a proper arrangement of the bars, and in good working order, are essential on every farm. The width of the gate should be 9 feet between the posts, which are sunk 3 feet into the ground, and rammed firmly

in the position with damp clay, as the safety of the gate wholly depends on their firmness in the ground. The posts may be of any hard timber, with an enlarged end under the ground. Six feet of an octagonal upper height, with top end neatly rounded off. The gate is made of fir bars, with the two ends of hard timber, on one of which iron thimbles are fastened near to the top and bottom to receive the iron crooks that are driven into the post, on the side or on the inside, according as the gate is hung to clasp on the post or to shut on the inside. The gate opens and shuts on the crooks and thimbles, and is closed and fastened on the other post by a small chain secured to the post, and to the head of the gate by a hook for the purpose. In this way the gate, on being shut, clips on the post, and is held in that position by the chain on each side. On shutting the gate it is held fast by an iron rod slipping along the upper bar into a hole in the posts, and this is withdrawn by a hand-catch when the gate is opened. These two modes of fastening gates are to be recommended, as no other mode of shutting is found that so fully prevents the jostling or playing of the gate less or more, either from the construction of the catch or from loosening by the use of the gate. The small chain is most effective, for it allows of the playing of the gate from passing over the hook end, and from nesting in the bended joint. The opening and shutting of the gate should be made so easy as to be done quickly by a person on horseback.

CHAPTER VII.

THE BUILDINGS OF THE FARM.

THE farmery, or homestead, is required for the purpose of accommodating in comfort, and with every convenience, the live stock of the farm, and for protecting from damage the implements and tools employed in the cultivation of the land. The dwelling-house, which lodges the owner or occupier of the farm, with his family and servants, claims the first consideration, in order to induce the residence of a skilled farmer with the necessary capital. The occupier requires the accommodation for living to be in proportion to the extent of the land, and to the amount of capital that is employed in the undertaking. It has ever been most justly acknowledged that agriculture has never obtained the position that is due to its value as the base of all other arts, for without it no other art can exist. The merit of the art is ever most unduly under-estimated, being reckoned an inferior calling and claiming a very subordinate consideration. Other classes of industry have advanced much beyond the position of agriculture, alike in the wages of its labour and in the dwelling-places of the labourers. Both the employers and the employed are placed under similar disadvantages in respect of suitable accommodation. This arises from the nature of the art in some degree, but chiefly from its low position in the scale of social and popular estimation. These considerations form a very great hin-

drance to capital being employed in agriculture, which is much increased by the slow returns of the produce, and the want of a due security in the length and kind of tenure.

The Roman writers on agriculture are very particular on the subject of buildings, as has been already observed, and as follows: "Ædificium pro agri merito et pro fortuna divi oportet institui."—(*Palladius, De Re Rusticâ.*) Our recommendation is exactly similar, and the following plans of dwelling-houses are designed on that principle, to advance the character of the art of agriculture, by showing the station it should occupy in an advanced position of social enjoyments. At the same time, no fanciful or outrageous expenditure is permitted or advocated beyond the legitimate wants and the just provisions in accordance with the attention that is given to other arts and callings.

The farms that are now under consideration, to the extent of about 400 acres, will employ an amount of capital of about £4,000, from which an income of £300 yearly will be easily obtained, by the employment of the money in other objects that do not require time and attention, of which the value is to be added to the rate of interest in order to be compared with farming, which demands the expenditure of both money and labour. A larger income may be confidently expected from suburban cultivation, for which the dwelling-houses can be altered and enlarged at pleasure, along with any architectural ornaments, as the present designs are very simple in that respect, and chiefly confined to affording sufficient extent of accommodation and convenience in the number of apartments required for the purpose that is contemplated.

The style of building is limited to an imitation of the

plain old English architecture, with a mixture of the Gothic in the roofs, doors, and windows. These small deviations from the naked monotony of the common style of building add little to the expense, yet show a

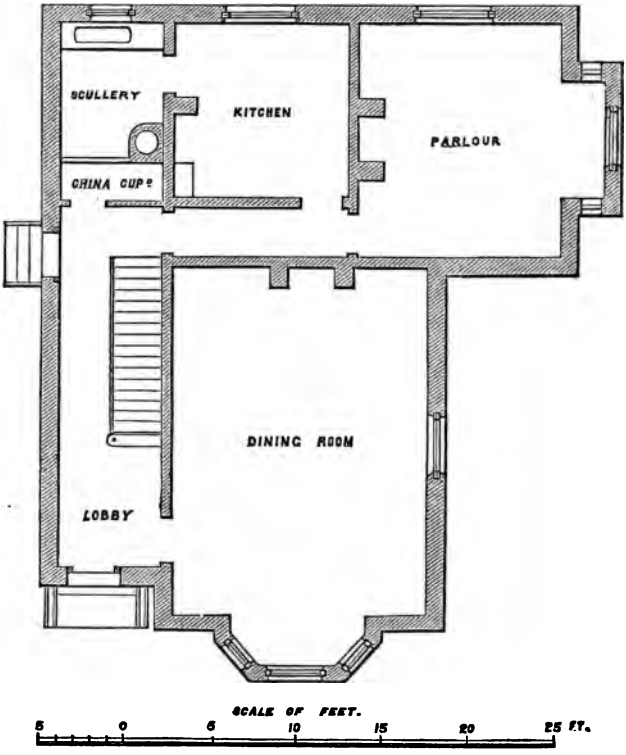


Fig. 34.—Ground Plan of Two-storied Farmhouse.

difference in that respect in consonance with the intended use of the farms. Convenience and utility are not to be lessened by innovations.

To the illustrations of farmhouses which we have

already given, we have added, in Figs. 34 to 36 inclusive, others of more modern structures, both as regards the way in which the accommodation is arranged, the nature of this, and the style of architectural ornamentation. In many modern houses the bay window forms

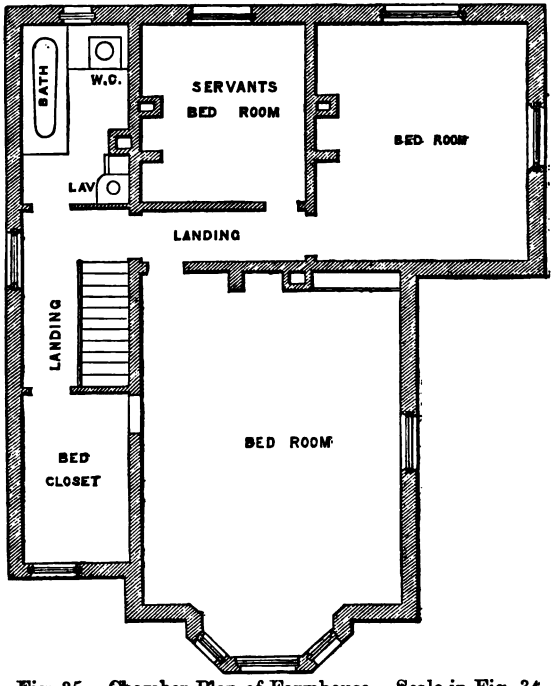


Fig. 35.—Chamber Plan of Farmhouse. Scale in Fig. 34.

an essential feature, and the style is, as a rule, confined to two "styles," namely, the domestic Gothic and the Italian, with modifications of these more or less decided, and in some instances so designed that the peculiarities of both styles may be met with in one house, giving it

some of the characteristics of the Italian or Venetian Gothic, if such a term may be applied to it.

Fig. 36.—Front Elevation of House in Fig. 34.

Cottages.

The slow and very gradual onward and upward progress of our social system renders it very probable, if not absolutely certain, that to a generation yet unborn will be reserved the being placed on a true and permanent foundation of competency and comfort, from what some seem to think would be a more just, or at all events a more equable, distribution of the national wealth, and that until that time arrives, the social position and comforts of the labourer must in a very considerable degree depend on the pleasure and benevolence of their employers, who are, as a rule, men of wealth. The up-

heaving, so to say, of the different strata of society, is liable to many disturbing influences, as well as to various subsiding actions—the distant connections as well as the very intimate ramifications of the various employments that are carried on in human society, all concur in a very powerful degree to render the prospect complicated, and any conjecture extremely uncertain, as to what time or in what manner the lowest members of society will be raised to the just and legitimate participation in the full rights and with all the advantages of society. Not the want of means, but the imperfect distribution of the elements of existence, conspires to render abortive the gifts of nature for the appointed purpose, and to convert the profuse, or at least the necessary, gifts of nature too frequently into an inheritance of degradation and want. But notwithstanding the very arduous and almost impossible struggle which is entailed on the progress of society, the instinctive principle of amelioration which is implanted in human nature is ever steadily at work, progresses stealthily when not openly, rises with renewed strength from every prostration which it sustains, pursues a steady course, overcomes every difficulty and levels all obstructions, and at last reaches the object which it is to be hoped will remain permanent. To render the transition from the condition which at present too largely obtains in rural districts, to this ultimate and desirable point of improvement, smooth and agreeable, with a steady upward progression, a cautious advancement is necessary, that it may not overstep the bounds of a reasonable requirement, and thus prevent those relapses and those stoppages which would very much protract the attainment of the ultimate object.

Labour is the source of every enjoyment of civilised

society, and it confers the value upon every work coming from or created by the hand or which is guided by the mind. Property is the purchase of capital, which is the accumulation of labour, and in every state of aggregated or individual existence it is supported by labour, which is employed by its enterprises, and adds to the extent of its enterprises and their value. No more intimate relation can possibly exist than between capital and labour, as the former is produced by the latter, which is wholly maintained by the fruits of its own exertion. But the rewards are very widely different—the circumstances of society have ever directed, and do yet apply much to the larger part of the fruits of labour to the reward of the capitalist, and human civilsation has not yet reached the perfection of universal charity and benevolence, which, without compulsion, will attend to the condition and relieve the necessities of its fellow-creatures, by whose labour its wealth is largely, although not wholly, created. The social condition of labour has been, perhaps, too much left to the direction of blind chance, and to the casual starts of a whimsical benevolence. Capital strives to get the full value of its outlay at the least possible cost, and not only in the amount that is given of exchangeable value, but also in the accommodation that is afforded to the hours of rest and for the renewal and refreshment of the wearied faculties. And the course of nature's laws having given the almost uncontrolled power to capital over the abundant supply of labour, a social condition has been produced amongst us which has perplexed the moralist and puzzled the philosopher, and has furnished the universal complaint, arising from reflection, for a very lengthened period of the nation's existence as a civilised community. The total abolition

of slavery and the establishment of free labour has, in many cases, only changed the name, and at best has advanced the sinew and strength of society from a state of inability to comprehend the degradation imposed upon them, to a condition which lets them see the deplorableness of their station without any prospect of relieving it. The mind has often been partially opened, while the physical condition has not been improved.

The very scanty allowance of provision which competition in our social system has, up to a very recent period, awarded to the employment of labour, is very much aggravated by the imperfect accommodation that is given in the shape of dwellings in which the labourers reside. These hovels, for by no better or higher name can they be called, have long been matter of loud and very just complaint, as reducing human beings to a condition far below that which they are entitled to be placed in, and in which, if employers had always consulted their own best business interests, they would never have been put. Even in the most favoured agricultural localities in Britain, where the land is most valuable, the landlords most affluent, and the farmers most wealthy, there are still to be found the labourers with large families huddled together into one apartment of about sixteen feet square, without any provision for the separation of age or sex, or any means of observing the common decencies of life. Such dwellings are only, as it were, the stalls of a stable or the accommodation of a dog-kennel—some dog-kennels we have seen have been superior to the cottages of the estate—where the animal eats and sleeps, and performs all the functions of life. In such dense huddlings the air is thick, vitiated, and unwholesome, and disease is engendered by reason of the want of separation, the duties and performances of

nature are too much exposed, and immorality is propagated from a too early period of life. The toils of labour are ill rewarded by evils of discomfort and the sight of misery during the short hours of relaxation, and with the prospect of a continuance of this wretched state of matters ever presented to the mind. The doom of labour would, in many instances, seem to be irrevocably fixed, and that, do what he will, the workman must be miserable. He sees his wife whom he values more than himself made a drudge and tool of toil and want, without the convenience of healthy action or any of its comforts. He feels her servile misery more than his own labour, of greater severity but of less menial discomfort, and makes more account of her being inconvenienced than of his own bodily prostration. A dirty hearth, a disorderly house, filthy floors, and furniture useless from want of room, instead of alleviating the irksome cares and toils of labour do very much add to its severity, and aggravate every feeling of disgust. Such scenes of filth and poverty create a universal aversion, and banish every hope of improvement or even the desire to attain it.

In the present transition state of the advancement of the lower members of our social system, the first object of attention is the separation of age and sex in different apartments; the next point is the separation of the sitting and sleeping rooms, and the provision of small conveniences behind or within the dwelling, in which to conceal the utensils of use that never should be seen, and in which to carry on those household operations which, when done in the presence of the family who are desirous of rest, add much to their discomfort and annoyance. For this purpose every cottage should have at least two apartments on the ground floor—a common

room and a better room—and not less than three bedrooms on the second floor, which must be at least ten feet above the under room in order to give the advantage

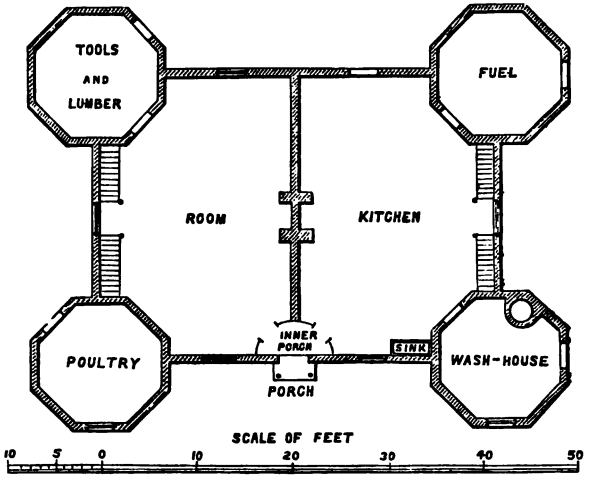


Fig. 37.—Detached Cottage for Labourers, with Bedrooms in Octagons.

of breathing a large volume of air; also a front and back door to promote ventilation. A square area should be

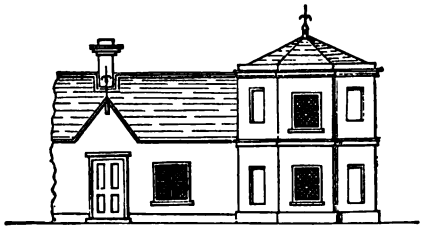


Fig. 38.—Half-front Elevation of Fig. 37.

placed behind to contain the necessary appendages, for the fuel, pig, poultry, washhouse, and lumber. It is essential that a piece of garden ground be attached to

every rural dwelling of about one-eighth to one-sixth

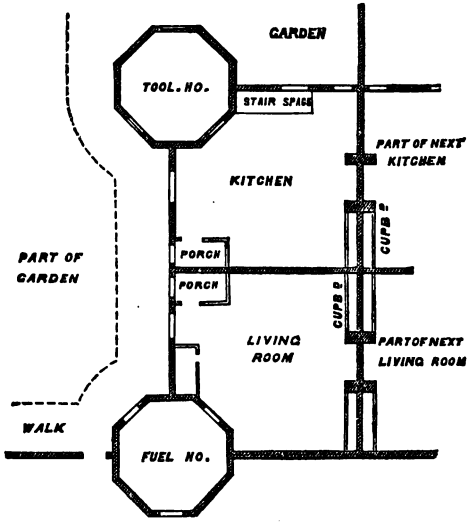


Fig. 39.—Pair of Semi-detached Cottages for Labourers. Scale in Fig. 37.

part of an acre, and that the cottage be placed in the central front of the garden, or, better, in the line of the

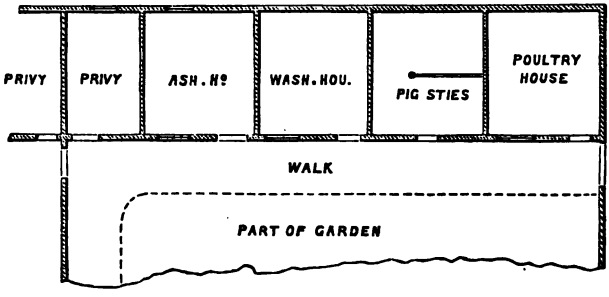


Fig. 40.—Plan of Outbuildings for Cottages in Fig. 39. Scale in Fig. 37.

square face of the allotment of ground. Vegetables are

the most wholesome of all edible substances, and the raising of these articles by cultivation forms a very agreeable employment to every member of the labourer's family. The keeping of a pig is most essential—the garden affords much of the requisite food, and the flesh of the animal constitutes a ready meat for the family, which does more to prevent marauding and poaching than whole volumes of statutes and penal laws. Two

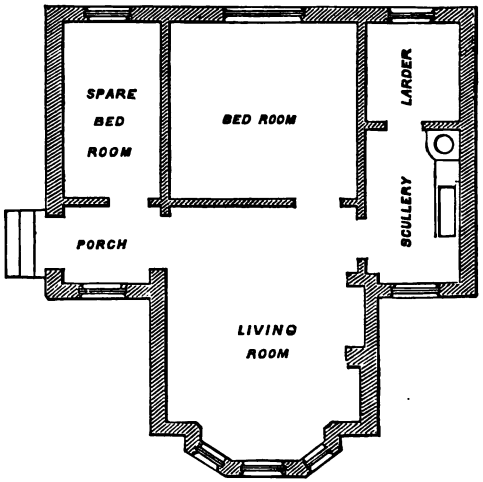


Fig. 41.—Plan of a Single-storied Detached Cottage for Labourers without Family. Scale, 1-16th = 1 foot.

pigs can easily be fed every year, especially when a plot of potato ground in the farmer's field forms part of the wages of the labourer. For a young family the milk of a cow is almost indispensable, as no other article within the reach of the labouring man, or of any other person, is so grateful to the taste or nutritious to the body. This fact needs no argument to confirm it. The cow may belong to the labourer when the farmer affords

the keep, or the farmer may find both the animal and the keep, and the labourer gets the produce of the cow as part of his yearly wages. In some cases the cow is lodged in the sheds of the farm, and often stands in a small byre at the cottage of the labourer. In either way, the arrangement of having a cow as part of the labourer's wages forms a most valuable addition to the labourer's individual comfort. Poultry forms also a very useful part of the employment of the family of the

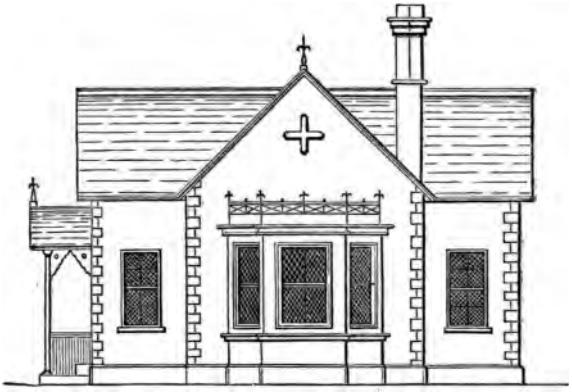


Fig. 42.—Suggestion for Elevation of Cottage in Fig. 41.

labourer, and provision should be made for the keep of the animals, and in comfort and with economy.

These various departments, while they minister to the necessities of the household, exert also a moral influence, as they occupy the attention of the labourer, and by imparting a delightful home employment a feeling of independence is raised, and the inclination which might otherwise exist to go to the public-house or beershop will be greatly lessened, and in time, in all probability, be wholly overcome. The best counter-

attraction to the beershop is that of the home, and this acts more powerfully when these various pleasant and profitable employments, such as we have named, are connected with it.

It is not a good plan to have a large number of cottages together, as in rows, as the number of people thrown together gives occasion to much idle gossiping and frivolous employments. Semi-detached or pairs of cottages are the best arrangement, except on very

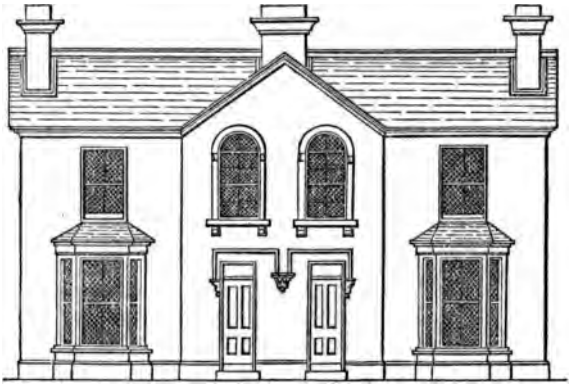


Fig. 43.—Elevation suggestive of Style for Double or Semi-detached Cottages.

large farms, where the size of the establishment may necessarily demand a row or street of them; but even then the semi-detached system grouped, but with garden spaces behind, will still be the best, with here and there isolated single cottages for labourers without families or for aged couples.

No landed property can be more profitably ornamented than with a suitable and necessary provision of commodious and economically constructed cottages. In these dwellings, humble though they may be, comfort can

be obtained and cleanliness displayed, and consequently they are fitted to aid in the social advancement of the labourer. These two adjuncts must never be lost sight of in considering the subject of cottages, for it would be worse than useless to build houses with accommodation and fittings beyond the means and the habits of the intended inmates, and it will be equally absurd to erect new structures in which no improvement on the old domiciles is made in either of the above points. The improvements may be very gradually made, but they must be made in the right way. Benevolence can scarcely be better displayed than in providing comfortable and healthy homes for the labourers of the farm. A clean hearth, a blazing fire, a snug and convenient house, commodious outbuildings, and a productive garden, all exert a powerful influence in attaching the labourer to the place of his work, and ensures his delight in its employment. The strength of a nation is formed by the number of its people, and these are strong or weak according as the affections are engaged or estranged. Moral strength occupies a higher position than the physical, and arises from the development of the mental energies. Competency and comfort amongst a people go a vast way towards enhancing national grandeur, which will be advanced, not exactly in the ratio of numerical amount, but in a far higher proportion.

The landowner provides the necessary structural accommodation of a farm, on which the farmer uses his capital with a view to remuneration for his expenditure and labour. The whole list of the various items of this accommodation does not contain any one item that is more valuable to the proprietor or more advantageous to the farmer than a proper number of convenient cottage dwellings, in which the labourers are lodged in comfort

and contentment. The farmer expects suitable accommodation for his family, his live stock, and implements. The live stock require, in addition, to have protection, and a comfortable and economic arrangement in their houses. When such provisions are not afforded, the farmer finds a difficulty in procuring the necessary labour, without which he cannot well carry on his business. The value of the farm is depreciated, and a carelessness is created in business. But when dwelling-house, farmery, and cottages are all provided in a superior style, an eagerness is immediately shown by farmers to obtain the land on which these are placed, and an unceasing desire is manifested to use capital with spirit and energy. The cost and trouble are quickly repaid by the rapid and permanent improvement of the farm.

The preceding designs of cottages are made with the view of promoting the objects that have been now stated, and to advance the progressive comforts of the labourer, with the gradual alterations that should be introduced. Changes, as we have said, must be gradually and considerately adapted to the means, habits, and manners of the existing circumstances of the class for which the buildings are required. It is hoped that originality has not been aimed at at the expense of utility, and that the desire to give ample convenience has not led to a useless extension of these or to unnecessary cost. The variety of forms or outlines may be both useful and pleasing, and may easily be made to suit different tastes and locations. A tame uniformity shows a paucity of conception and narrowness of view —variety is ever pleasing.

The disposition is much to be reprobated of making cottages for agricultural labourers fanciful and expen-

sive. More than the mere pleasing of the eye, there must be considered and adopted the essential accompaniments of space, light, ventilation, and drainage. A well-arranged plan gives a large amount of healthy accommodation in a small space. All ornament must be made subservient to comfort, and not *vice versâ*, as is generally the case. High estimates for fantastic ornaments very effectually deter the building or alteration of cottages. Three being built for the cost of two might alone induce the landlord to make a beginning. The health, cleanliness, and moral condition of the labourer is more intimately bound up with a better class of dwellings, which renders the question one of vast practical interest to every possessor of land, and to the prosperous existence of the labouring community; and there is thus also discharged a part of the heavy obligation which property owes to poverty.

Design and Construction.

The principles upon which the buildings should be arranged as regards accommodation, and constructed as regards style of ornamentation, have been clearly explained.

Three essentials are strictly insisted upon—that there be at least two apartments on the ground floor of each cottage; that the sleeping apartments are on an upper floor, which contains at least three rooms; and that there be some small buildings for minor purposes, various conveniences, as scullery or wash-house, coal-place, &c., &c. A garden is attached, the position of which altogether depends on the surface or the locality, so that no particular directions can be given here respecting it.

The foundation is dug to the depth of two feet, and filled to the level of the surface with broken stones on which the building is erected. This interstitial cavity secures a dry foundation, and the water flows to a corner of the bottom which is inclined for that purpose, and is conveyed away in a covered drain. Or a platform of stones may be raised from the ground, and the cottage placed upon it, for which the stones are made level and of moderate size. A dry floor is essential to every dwelling. The walls of the cottages are built with stones or brick, with lime mortar; the roofs are done with common timber, and covered with slates or tiles, as convenience may direct; the floors are formed with flooring bricks; the living rooms may be laid with deals of common fir, with which the bedroom floors are also provided.

Farmeries.

All practical men have agreed, for a long time past, that there is not at present a wider field for improvement in any branch of rural economy than in the arrangement and construction of farm buildings. Very great and beneficial alterations have certainly been made within the last half century or more, and which are in some degree corresponding with the improvements in other branches of the art of agriculture; but in many parts of the kingdom it may be seen that improvements have not yet commenced, and even where a very considerable progress has been made, or at least attempted, a suitable effect has not been produced, from want of the necessary knowledge and judgment, in adapting the extent of the accommodation to the purposes required, and in combining the utility of the concern with the proper expenditure. From looking at

the present state of farm buildings in some districts of the kingdom, it might appear that ingenuity had been employed to devise and erect the most awkward and useless farms imaginable; declivities are chosen for sites in order to keep the yards dry, and at the same time discharge all the moisture into ponds and ditches, or into the ruts of a public road; the straw lies dry and unreduced, and very unfit for the purposes of manure; the houses are scattered and disjointed, and require a useless quantity of fencing to connect them, and of expenditure of time and labour in going from one to the other; the yards are large, open, and exposed, and afford a very insufficient accommodation and shelter to animals, and no ready means of preparing manure in the most economical and proper manner. The useless expenditure in erecting large flail and timber barns has been condemned by all enlightened practical men—an expense double what is required being expended on that point alone. The general aversion to advance an outlay of money, and the very strong inclination to use the old erections at the least possible expense, and to repair and patch as long as possible, very much retard the progress of improved farmeries, and the want of security in any person but the landowner expending capital even for such a necessary and essential purpose. An improper expenditure might no doubt be incurred by making very extensive alterations at one time; but but by gradually introducing the best plans as occasions may require and opportunities are offered, an important and valuable change would soon be effected, which would have a very different result from the frittering policy often pursued of expending money on many points, which serve only a temporary purpose, and which, if combined and directed to one or more

chief objects, would introduce some positive benefit in one place, and then to others, as it may be successively required.

In consequence of the aversion often held to the outlay of money that is required, and the general adoption of a temporary system of management, comparatively few opportunities are found of erecting a suitable and economical farmery on any lands in cultivation; but many farmers will not refuse, along with a lease of the proper duration, to pay the usual interest on the cost of an improved farmery for at least twenty years, making the erection an inducement to offer a higher rent, and a capital paying the usual yield of profit.

It will be said that improvements can be made, and that alterations may be real and all very good, but are not required—reasons not to be admitted by any intelligent mind. In many places, where large sums of money have been expended in erecting farm buildings, the most glaring blunders have been often committed, and much ignorance displayed, even of the most simple and evident details of practice, arising from the incompetency of the persons employed, who have never practised the art they profess to assist, and therefore do not know the wants they attempt to supply.

The landowner often makes an unnecessary expenditure in useless erections of fancy, or is led away by the plans of architects who, however well qualified to plan and build houses, experience has shown to be most miserably deficient in contriving and placing the accommodations that are required on an extent of land adapted for a special cultivation. The economy of labour that is derived from the juxtaposition of apartments, &c.,

that are required to be used in combination, is wholly disregarded, if, indeed, known to many of them. Barns and rickyards are placed at the opposite sides of large farmeries, stables and cart-sheds in a similar manner, and the granary placed at a distance from the barn, all creating an unnecessary labour in travelling from one place to another. The work-horses often enter through a cattle-yard, and in many cases must travel round the farmery to reach the stable and cart-shed. Pigs are huddled into some cold dingy corner, and poultry are similarly treated, while the door of the house opens to the north. These two kinds of animals require much warmth and a sunny exposure, and the general arrangement is often just the reverse. Many similar blunders might be pointed out, which must be obvious to every experienced observer, and which abound in many publications on the subject.

However simple the subject may appear, no person is capable of devising plans of convenient farmeries, or of illustrating any practical art, without the most intimate knowledge obtained from long and extensively varied experience of the most minute details of its practice; and the first requisite is to ascertain the number and size of buildings that may be required for any lands under a certain system of cultivation, without too much curtailment to create inconvenience, and without any useless appendages that require unnecessary expense; and then into one general whole to connect them so as to afford the greatest possible convenience with the least possible labour in working them.

In planning farmeries, the buildings are often too much extended, which makes the whole area cold and uncomfortable; or the buildings are huddled together into a close confinement, and consequently become defi-

cient in ventilation and fresh air. The Roman writers on rural subjects seem to have been well aware of the just proportion of buildings, and with the extent of the occupation. "Majora enim tecta et ædificamus pluris et tuentur majore sumptu—minoracum sunt quam postulat fundus, fructus solent disperire."—(*Varro, De Re Rusticâ.*) The unnecessary original expenditure, and the constant repairs, are here well defined. The buildings are best arranged in the shape of a parallelogram, or oblong square, of which the two sides may be one-fourth longer than the other two that are opposite—and open, in order not to exclude the warmth from the interior area. The granary must look to some point of the north, being a quarter of the heavens which, in Britain, will make the live stock departments range from south-east to south-west, as the locality and natural exposure may direct. On this point the Roman writers are very acute, pointed, and expressive. "Sed totus fabrica tractas unius lateris longitudine, in quo frons erit. Meridianam partem respiceat in primo angulo excipiens ortum solis hyberni et paululum ab occidente avertatur hyemali. Ita preveniet, et per hyemem sole illustretur, et calores ejus æstate non senteat et lato fructur aspectu."—(*Palladius, De Re Rusticâ.*) The position of the farmery must be as central as possible on the farm, and near to a public road, but not too close to it, and on a gently rising ground that slopes from north to south, and is dry in the bottom. The front of the square is an open exposure, which admits the low buildings of a piggery and poultry-yard being placed before the walls of the yards without excluding the warmth from the interior area. The rickyard must have an exposure to the north, the thrashing-barn being placed centrally to the north of the square, with

the straw-house. The open cart-shed is adjoining, with the granary over; this gives the grains an airy position, which is an excellent arrangement. The stable and tool-house join the cart-shed, to afford a ready access to the implements of every kind. The granary receives all dressed grains, which are hoisted from the barn, and extends also over the stable, to which the oats, &c., forming the horses' food are passed by means of a "shoot" conveniently placed to the corn-chest or "bin." The grains to be dressed and sacked, ready for sale, fall to the ground-floor from the threshing-floor above. The stable and cow-shed are conveniently entered by an end door, with an opening in front, to discharge the dung into the yard. The calf-pens must open into the cow-shed for the convenience of suckling the calves. Fattening-houses have roots and hay stores close at hand.

The sides of the oblong square must contain all the necessary accommodations without any disjoined buildings, appendages, or lean-to's, or, at least, with as few as possible, or best with none at all, as in the other elements are great disfigurements and add to the expense. Separate buildings in single positions, or in ranges, are expensive in walls and detached roofings, and convert the farmery into somewhat like a village, with streets, lanes, and alleys, with the back positions cold and dreary from want of the heat excluded by the front buildings. An equal exposure must be given.

The cattle-yards are basin-shaped in the bottom, which is cemented or pitched to retain all moisture, for no better use of liquids can be practised than by absorbing them with straws, &c., &c., and no better mode of treating cattle can, perhaps, on such farms as we are now considering be adopted than keeping them in

yards with shelter-sheds, to contain the proper number of young and fattening animals.

Water is supplied to all necessary places in troughs fed by ball-cocks, from pipes attached to casks or tanks placed in the open roof of the cart-shed or cattle-sheds, to which the water is raised by a pump, or from a spring on some high ground. All the roofs should be supplied with gutters, and these should lead the rain water to appropriately placed tanks or cisterns, as the rain water is the softest we have at command. All the houses and yards are supplied from this source by pipes.

The use of the flail in threshing grains in large barns of timber and thatch is now wholly discarded in all improved farms. Horse-gear is sometimes used in small farms, but it should be dispensed with, as it involves exceedingly severe labour on the animals. Whenever water power can be obtained, it should be made available; although its supply fails at times, still it is the cheapest power which the farmer can have at his command, and by the use of a turbine or pump a supply can be stored up in tanks, to use when the main source fails through drought. This arrangement is especially useful also for the supply of water in the buildings at pleasure. The plan here described, or rather briefly alluded to, is one, perhaps, only adapted to small farms, although a source of water conveniently placed in a large one may be economically availed of to supplement the steam-engine, which is always, or should be, employed as the motive power. Steam power, as a rule, is used on all farms above 200 acres.

Farmeries of any kind that demand the moving about of large bulks of food for feeding purposes, &c., &c., will have this work done in the quickest and most economical way, by the adoption of tramways, placed at

every point likely to be useful in the saving of labour and in the quick conveying of food, &c., to the various apartments. These tramways may convey the grains

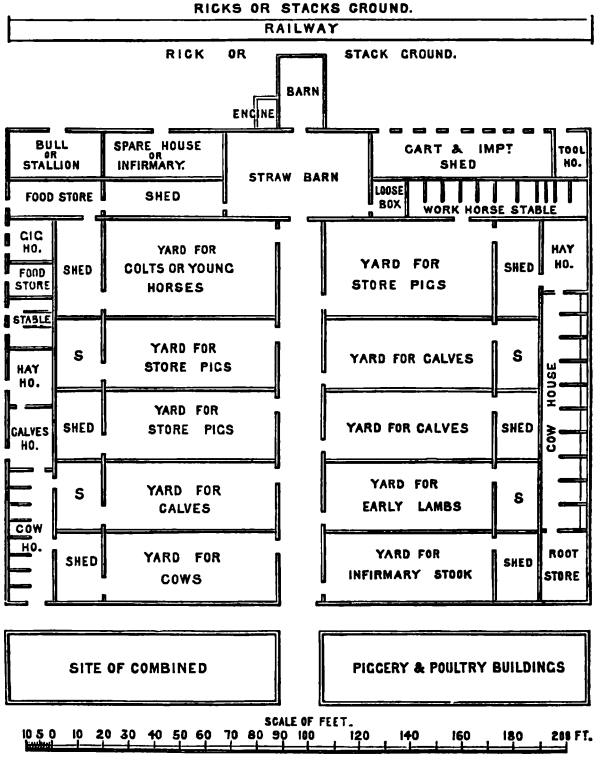


Fig. 44.—Plan (square) of General Farming for a Farm of from 300 to 400 Acres.

to the threshing-barn from the ricks standing along the line, all straws and hays to the cattle-yards, with the roots, and bring the roots and meals to the steaming-

house, and thence to the animals for food. Steam power threshes the grains and raises to the granary the dressed grains for storing up; works the root-slicing and cutting and pulping machine, and the hay and

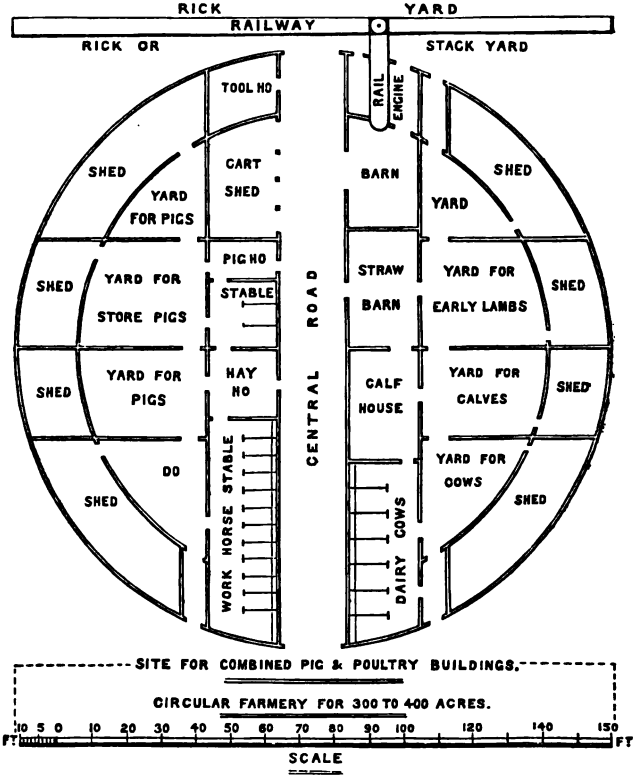


Fig. 45.

straw-cutters for chaffs and litter. The use of steam and of the railway in farmeries shows the advanced progress of the applications.

In these designs of farmeries, square (Fig. 44) and

circular (Fig. 45) in form, the corn-ricks are placed along the sides of a railway beneath a circular roofing of zinc or corrugated iron, supported on cast-iron pillars, and are wholly covered by the roof on both sides, and which not only saves the expense of thatching the ricks, but gives other and obvious advantages. The roof is formed in pieces, and fastened by screws to the plates that rest on the pillars, and are removed and replaced to admit the building of the ricks. A light iron waggon on the railway conveys the unthreshed grains to the end of the barn, on which a travelling carrier, impelled by the steam power, conveys the sheaves to the third floor of the barn, close to the threshing machinery, from which the grains fall to the second floor, cleaned from the chaff and riddled, and descends to the ground floor with the small grains, which are there separated by fanners and hand-riddle, and measured into bags for sale or use on the farm. The straws from the threshing-machine are spread on the boards of knives impelled by the machinery, and cut into short lengths for litter, and chaffs in shorter lengths, which drop on the lower floor of the barn and are stored for use in the chaff-house. The litter falls upon a travelling web, impelled by the machinery, from the highest floor of the barn, which passing through the main doorway overhead, and being supported on triangular props that are movable, conveys the litter into the yards in succession. The hays are cut into chaffs by the same process. Litter in short straws is very conveniently managed and covered in the land, and readier mixed with the solid dung and impregnated with the urinary fluids. By this method of working great economy is effected in the feeding and bedding of the stock where straw is used.

The cart-shed looks to the north, to keep the implements from the sun; the tool-house is convenient to it, and the stable is convenient to get litter from the straw-barn, and oats and beans for feed by shoots from the granary. Cattle not being kept, at least but to a very limited extent, on the farms now under consideration, the yards are, therefore, almost wholly tenanted by swine, cows, and calves, to be distributed as convenience may direct. Store pigs will find a most comfortable bed in the yard of the stable, among the dung of the horses, and one or two yards will be required for early lambs, and the other yards for the cows and calves as may be required. The cows occupy double stalls, and the calves in single cribs on boarded floors, which are warm and airy. The animals are led to the cow-shed adjoining to be suckled, and returned. The yards are basin-shaped or concave bottomed or floored, and cemented to retain the moisture. The litter must be spread to a level surface, so that each part be trodden by the stock in a like proportion. Store pigs are most excellent manufacturers of manure, from their constant work in turning over all the materials, and from the very large amount of their solid and urinary voidings, as they use such ample supplies of food in raw roots, clovers, and vetches.

The pigeon-house, clock, and weather-vane over the main entrance of the farmery, will be very useful, and impart a pleasing effect to the buildings.

The piggery and poultry-yards, the occupiers of which are fattened wholly on the produce of the land, may be enlarged by using some of the yards of the farmery for the store animals, and pigs at liberty, with good shelter and the necessary food, will fatten not the less quickly than when placed in the confined sties.

The present arrangement employs both methods—with cooked food in sties, and in yards and sheds, the stock being fed with raw meats from troughs and cribs, with a dry warm lair and an ample littering of short straws. In the piggery, all the sties, as well as the poultry-houses, are heated underneath the floors by a pipe passing into every house and corner, with hot water from the fire-house in which the meals and potatoes are cooked; the water may be returned to the boiler by a constant running, or let off by a tap at the extreme end, and into the pond in the yard of pigs and poultry. This application of warmth will be very highly beneficial to pigs and poultry, which enjoy much heat, more especially with the floors laid with boards, in order to be easily warmed.

A pump sunk in the likely place to obtain water, but which may be got in any position by sinking to a sufficient depth, will distribute water in pipes to all places where it is wanted, as the presence of water is the most essential provision to every habitation of organic life. The water must be supplied by ball-cocks into all troughs and ponds from a cistern on higher grounds, where the spring arises; and where this advantage cannot be found, casks are placed in the open inside roof of the cart-shed, or the yards, to which the water is raised by the force of the common pump, with the upper valve fixed down by a screw-rod firmly attached for the purpose, which drives the water into a pipe placed between the valves leading to the casks, and which, being withdrawn by reversing the screws, the pump is again converted into its common purpose. The water is conveyed in pipes from the casks to every convenient place of use, and regulated by ball-cocks for the supply of troughs and ponds. This mode of

supplying water is very simple, effectual, and easily performed.

These farms now under consideration will afford every opportunity of carrying out the most advanced practice in the cultivation of the lands, and in the appliances and management of the different departments of the farmery or buildings. In the last-named system, for example, it has been shown, that by the use of tramways, in conjunction with steam power, the highest economical results can be secured. It remains to be seen whether this power can be made available to the general work of the farm. So far as the moving of heavy implements, &c., is concerned, it has been successfully applied through the medium of traction engines; and these, or some other mechanical systems, may yet be so extended in their working capabilities as to undertake a far wider range of work than has yet been attempted. Recently, however, the wire-rope steam cultivating system has been applied to such operations as harrowing and rolling, and an experiment has been also made very recently to test the applicability of self-propelling steam-engines to the reaping of corn. That we are on the eve of quite a new era in farm work, aided by steam, abundant evidence there is to show, at a comparatively small outlay, by the application of some of the more recently introduced and simple forms of tramways. On the field the tram must be formed of timber, and movable. This arrangement being obviously applicable to the conveyance of manure, &c., &c., to, and of produce from, the field, the difficulty to be overcome does not lie in the hauling part, but in the application of the surface on which the engine is to run; but this, in time, will likely be overcome. It will, however, only be on large farms

that such mechanical aids to the general work of the fields can be used.

An extension of the plan of a circular farmery will cover the whole area over the outer wall with glass, like the terminus of a railway, and may be contrived to include the ricks of grain in a central position therein. But covered steadings and corners generally produce cold draughts, and the warmth of the returning suns of spring is very agreeably beneficial to animal life. The price of glass seems, therefore, to prohibit the use of it in this mode of application.

The reaping of corn by horse machinery and the ploughing of lands by steam power have been tested by a wide variety of modes of application, and have succeeded, as many similar inventions have done, in giving the greatest satisfaction under the most favourable circumstances for their application. The original cost of the latter is high, beyond the means of those who cultivate small farms.

In connection with the use of the power of steam for the doing of the general work, it should be stated, however, that in proportion as horse labour is dispensed with, the supply of manure is lessened. This point, as well as others which have been referred to, will show the reader that farming, in any one of its various departments (see the Editor's volume on "Landed Estates Management"), is a profession which demands the exercise of careful consideration in every detail, and is not the haphazard, easy-going, nor easily-practised one which is assigned to it by popular opinion.

APPENDIX.

To increase the practical value of the present volume, the Publishers have thought it well to append the following useful calendars selected from a number of such, contained in the last edition (1877) of their well-known and standard work "The Complete Grazier."

It should be mentioned that, as the Farmer's year, from custom, and in most instances from convenience, generally commences at Michaelmas, these calendars have been drawn up with reference to that circumstance.

DAIRY COW CALENDAR.

OCTOBER.

Those cows still kept out at pasture should have the poor feed of grass which they now yield supplemented by such cut forage food as may yet be in stock, this being given to them in the field racks or the feeding-cribs of the shelter-sheds. If cut and mixed with the straw of the new cereal crops of the season, together with the allowance of oil-cake or home-made meals, the food will not only be more economical but more nutritious. Take the cows into the house at nights, as the night air at this season is cold and raw, and early frosts may set in. (Better results in every way will be obtained by giving up the system of pasturing, and housing the cows wholly.) Should the weather turn out thoroughly wet during the day, the animals even then should be housed, well rubbed down with dry straw, and have a warm mash given them. Do this also when taken in at night under the like circumstances. Feed the cows which are stall-fed

or soiled with regularity, carefully avoiding long intervals between feeding-times. Clean out and keep scrupulously clean all feeding-vessels. Whitewash the walls, previously brushing them down to free them from dust, cobwebs, &c., &c. Take advantage of the animals having their daily turn in yard or paddock to thoroughly clean out the whole interior of house; wash down all the woodwork, and make all neat and tidy for the winter feeding.

NOVEMBER.

The work to be done this is very similar in its general character to that of last month. Cows out at pasture, however, should now be brought into the house for the winter season. In very damp weather with low temperature give a warm mash in the middle of the day, and keep them wholly in the house, omitting even the daily short run in the yard or paddock. Pay particular attention to the cows selected to be sent to the forthcoming cattle shows, to see that their general health be good. Give them food calculated to increase the flow of milk. Be careful to currycomb them regularly. Keep their coats free from all soiled matter. Select calves from those calved in spring to breed from. Weed out those which give the best signs of being fattening rather than milking beasts. Keep a regular diary of the "doings" of all the stock—meat they consume, milk they yield, &c. &c. Clean out all stalls, and whitewash the parts which appear to be getting soiled.

DECEMBER.

As the cold increases, add to the bedding of the cows, and let the food be mainly given as warm mashes. Pay particular attention to the bowels. To those much constipated give an increased allowance of oil-cake, and if this be not effective in getting rid of the complaint give at first a slight purgative. Let this have ample time to act on the bowels; do not force action by increasing the dose. Give rape-cake to those cows in milk, the yield of which seems to be falling off, in a mash of moderate warmth, but of thinner or more fluid consistency than usual. Decrease the number of and reduce the thinness of the mashes of cows about to be or now being dried off for calving. Do this gradually, and note the effect upon the bowels. Give food of moderate richness only to cows near calving, and pay particular attention to their health.

JANUARY.

To cows in full milk give ample supplies of nutritious food, those substances being chosen which are known or found to increase the flow of milk rather than those which have a tendency to fatten. If the recommendations in the text have been followed, add to the other foods cabbage. Give changes of food from time to time. Give rape cake, as of the oleaginous foods it is best adapted to this purpose. Where quantity rather than quality of milk is desired, give good feeds of thin liquid mashes; if near a town, use liberally grains or distillers' wash. Avoid giving heavy meals of raw cold roots to cows near their calving, slicing or pulping them, and mixing them with other foods. To cows within two or three weeks of calving begin to give daily an allowance of three to four pounds of the best oil-cake. See particularly to the state of their bowels, which keep gently and freely open. Cows "noted" to calve about the middle or end of March should be begun to be dried off. Do this carefully at first, gradually decreasing the quantity of milk taken. When the udder gets hard and with a slight tendency to inflame, rub it gently several times a day and with a simple cooling unguent; camphor pomatum or oil is the best. Rub only with the hand if no tendency to inflammation shows itself. Keep cows near calving housed. Bed all the animals with sweet straw, and clean out carefully all the stalls and gutters.

FEBRUARY.

Be careful as to exposing cows in calf, and especially those near their time, to cold weather and damp and rain. Should they get by chance wet, house them quickly, and rub them down with dry straw. Give them dry bedding and a warm mash. Give cows in full milk as juicy and succulent food as can be got; slice or pulp the roots, cut the straw into chaff, and make the whole into a mash, not too warm, but thinnish in consistency. Keep giving changes of food, substitute occasionally for the ordinary swede the mangold or the parsnip. Add also meals of home-grown greens, and if to be had at a moderate rate, keep giving feeds of brewers' or distillers' wash, to promote flow of milk. Give drying cows a modicum of hay daily, and to those near the time of calving four to five or six pounds daily of oil-cake. Keep the temperature of the house

comfortably warm, but not close. Study the way in which the winds blow, and open and close the fresh-air ventilators accordingly. Towards the end of the month all the animals will be the better if a portion of sulphur is added to their food, say every other day, for a week. Keep the stalls, woodwork, and gutters thoroughly clean. Currycomb all the animals at least twice a week, thoroughly but yet not roughly—there is great art in currycombing properly—and rub them down with dry straw each time they are cleaned and bedded up. The gentle friction caused by this, especially at bedding up for the night, reduces restlessness, and predisposes them to sleep and quietness.

MARCH.

Exercise caution in exposing the animals, especially those which have recently calved, to the somewhat tempting yet withal treacherously cold and bitter winds of the early part of this month. If let out for an airing, the yard will do better than the paddock, as the sheds will afford shelter when required. See caution given last month as to cows getting wet. See to the condition of cows about to calve as regards their bowels, and do not omit their daily allowance of oil-cake. Remove them to a loose-box or roomy double stall; the first is best. Much danger is to be apprehended from the really cruel system of allowing cows to calve when tied up. Give cows which have calved warm drinks, avoiding the giving of large draughts of cold water. The food should be at first thin but moderately nourishing, increasing the nutrition gradually. Rich food given suddenly is apt to induce milk fever. Draw off the milk frequently, yet gently. Keep down all distention of the udder, and look carefully for all appearances of inflammation in the same. The gentle rubbing of the udder by the dairymaid will be peculiarly grateful at this time to the animal. This process has often been found preventive of bad attacks. Remove frequently the old bedding, and renew it with clean sweet short-cut straw. Give a handful of good hay occasionally, and keep a lump of rock salt in the manger for the animal to lick at.

APRIL.

Cows soiled should have to their other and ordinary food cuttings from the tares and winter rye, breadths of which

were sown the autumn previous. Take care not to cut this food unless sufficiently advanced, which may be the case if the season has been backward; by cutting too early much of the crop may be lost, while the food is not so good for the cows. Gradually accustom the cows to this green food. Bring in cows turned out to pasture at nights, and keep them housed on such cold, wet, and raw days as happen during this month. Keep cows in full milk housed, as they will yield more when not exposed to the cold of the pastures; if rape, or vetches and rape, has been sown the winter previous and it be sufficiently ripe, give to these, cuttings twice a day; this will promote the flow of milk considerably. For other treatment as to food, &c. &c., see previous months.

MAY.

Cows which have recently calved and are in full milk should now be yielding the largest profit. Much will, however, depend upon the feeding and general treatment. As green food ought now to be had in abundance, feed the cows liberally upon it, taking care to accustom them gradually to it. Give as frequent changes of food as possible, and if soiled—as this will pay best—turn them out to the yard or paddock daily. Clean and currycomb the cows regularly, and well ventilate the byres or cow-houses. Pastures should now be at their best, the grass being sweet, succulent, and plentiful. Turn out cows designed to be pastured; but, especially in the case of those in full milk, it will pay best to house them at night regularly. In thoroughly rainy days keep them also housed.

JUNE.

Keep changing the fields for those cows at pasture, so as to afford them the advantages of change of "bite," as well as to give the grass an opportunity to grow. Avoid the over-stocking of pastures, as both they and the cows feeding off them will suffer. Cows soiled in the house and court should have cut grass given them as change from the other green forage now in abundance, the various succession of crops coming in regularly to keep up the supply. House cows at night which are pastured. Attend to the health of all, especially those about to calve; to these give for the last

fourteen days a full allowance of the best oil-cake. Give to cows brought in at nights from pastures a "handful" of good hay and a little oil-cake; increase the allowance of this, and the varieties of food, to those which appear falling off in their milk.

JULY.

The remarks of last month will apply to this nearly wholly; but if shelter-sheds be not provided in the fields, take special care to house the cows during the hours when the "fly" is doing its worst wherever it can. Cows near calving, or far advanced in calf, should, indeed, be housed during the very hot weather, as great injury may be done them by being "gadded." Under rather than overstock pastures, and see to the supply of water that it be abundant and good. Keep changing pastures.

AUGUST.

Look at the state of the pastures, as they begin to fail in the dry weather which this month is so often prevalent. In such cases, reduce the number of the cows pastured, or change them to a better grassed field. But with failing pastures it will pay better to soil the cows in the house or in the sheds and courts. Attend to the general health of cows; give all in milk a regular supply of oil-cake. House pastured cows during very hot days, or at least during the hours when the fly plague is at its worst, and house them regularly at nights.

SEPTEMBER.

Failing and failed pasture-fields being now pretty universally the rule, give to cows kept regularly out proper supplies of other food, as cut green forage food, rape, mustard, tares, &c. &c., and on housing them at night a bit of hay and a modicum of oil-cake. It will be advantageous to cows in milk to give them towards the end of the month cooked food at least once a day, the last meal at night being the best time. Cows regularly soiled, if green forage food be yet moderately abundant, need not have this cooked mess till further on in the season, or unless they begin to fail in milk. See to the health and general condition of the cattle, and begin preparations for the coming winter season.

PIG CALENDAR.

OCTOBER.

Put up store pigs which are advanced enough to begin to be fattened, feed them liberally on the best food at command—corn and peas, beans, &c., and hard grains, forming part of their food, with the usual liquid fluids, as dairy refuse, mashes, &c.

Fattening pigs, nearly ready for the butcher, should be finished off with regular feeds of thick meal mashes, oatmeal being reckoned the best, maize next in value; a little bean meal will give firmness to the flesh. Keep store pigs regularly and progressively improving, the best picked out for future fattening; and sell off, if desired, such of the others as can be spared. Give young pigs, of the last farrowing of the season, as much of the best part of the dairy produce as can be spared from the feeding of the fattening hogs and such sows as may have litters. Mix occasionally some meal with the milk, which should be given in a warm state, especially towards the latter part of the month; an occasional feed of cabbages may be given then. These with carrots, mangolds, turnips, will form an excellent food for store pigs, in the form of boiled mashes, to one of which in the day add a little meal. Feed sows with litters on warm mashes and not too thick. In all cases the sties and feeding-troughs must be kept scrupulously clean, the bedding of cut straw frequently removed, to avoid the accumulation of dung.

NOVEMBER.

Put sows in good condition to the boar, to have farrows in March, the first of the season. Give sows which may have litters warm mashes and abundance of dairy refuse, such as whey, butter or skimmed milk. For fattening pigs give mashes, as stated under last month, making these more nutritious as they approach the selling period. Attend to the careful bedding of all the stock and to the careful cleaning of sties, troughs, and bodies of the animals alike; especially in the latter case with fattened pigs about to be sold, and swine with litter.

DECEMBER.

The general treatment of the whole classes of stock to be very much the same as described under last month; but the more severe the weather, the less the quantity of cold food given them the better, roots and green food in all cases being given warm as mashes. These, in the case of fattening pigs, to be thickened with meals (*see* October). The bedding must be especially attended to. That in the yard may be cut, but in the sheds of the sties should be long straw, especially in the case of young pigs, so that they can burrow under it for warmth. There is no animal of the farm so sensible to cold as the pig; none suffering so much and deteriorating so much under its influence.

JANUARY.

Keep pigs fattening for bacon regularly and well fed—mashes such as we have described under October, roots and cabbages forming the basis, with the addition of such dairy refuse as can be had, and brewers' and distillers' liquid, and solid refuse grains. Young pigs of the last autumn's litter should be provided as liberally as possible with dairy refuse; a good mixture with the latter being bruised peas and oats, with occasional additions of carrots or beetroots and cabbages. Sows which have been put to the boar for spring farrowing to be kept in good condition, with ample supplies of nearly all the kinds of food which the regular systems of cropping which are supposed to be carried out on the farm can afford.

For remarks upon general work connected with littering, &c., *see* previous months.

FEBRUARY.

Sows expected to breed in March must be carefully attended to, special attention being paid to the condition of their bowels, to avoid undue constipation, which may be said to be the foundation or cause of nearly all complaints. Put up for fattening such of the store pigs as may be ready. Commence the richer foods, now to be given, gradually increasing as they get near the period of finishing off. The food should consist chiefly of warm mashes of boiled roots, parsnips, if to be had, forming the largest portion, these being specially adapted for pigs. The

mashes should not be too thin, but rather thick, approaching almost to the solid; and as the fattening proceeds, increase the quantity of meal, which should form one of their constituents. Potatoes also may be used for mashes, and now and then a handful of one or other of the best artificial or condimental foods may be given with advantage. Salt is said by some to act prejudicially, if not indeed, as others maintain, as a direct poison; this may be when given in excess, but we have always found that when given moderately, that is in quantity sufficient merely to flavour the food, and take off its natural insipidity, that the pigs have always relished the food more keenly, and have at all events appeared to thrive exceedingly well. Another food, if it can be so called, or condiment if one wills, is coals, of which all pigs are exceedingly fond, why no one has yet been able to say; but the fact remains, that they eat them with such avidity, as to make it appear that they are essential to the maintenance of their good condition. Cinders are sometimes given, but coals appear to be best, which should be given in smallish pieces, about the size of an egg; too much should not be given. We incline to believe that coals act beneficially upon pigs on account of the sulphur they contain. Sulphur, indeed, should be given in occasional small doses to pigs.

MARCH.

Make preparation for the farrowing of sows, which should take place chiefly this month. Have the sty thoroughly cleaned out, feeding-troughs, &c., and good sweet litter supplied in abundance. Fix a board at the sides of the sty after the manner of a lean-to or shed roof, leaving a space below it into which the young pigs may run, as the sow, especially if large and heavy, is apt to overlay them, crushing them up against the walls, as all pigs in lying down prefer to have something solid to bear upon. Provide a hamper to the sty when the sow is about to farrow, into which the young pigs should be put as they are born, and kept till the labour of the sow is completed; after which, the pigs must be returned to the sow to suckle for a short time. When satisfied, the pigs must be put back into the hamper provided with a fresh supply of cut straw; take out the wet litter from the stye, and replace it with dry cut straw, then

restore the pigs to their mother. Pay close attention to her, that she does not show a desire to eat her pigs. The treatment of other classes of stock is the same as the last two or three months.

APRIL.

Pay particular attention to farrowing sows and their litters, the latter receiving with advantage, about the age of five or six days, and for some time after, a separate food at least once daily of warm milk thickened with a little meal, the use of barley-meal being avoided. Give the sows warm mashes moderately liquid, attend carefully to their bedding, so that it will be dry and warm. Bring on store pigs progressively into a condition fit for fatting. Every variety of food will be taken by them if of a good breed and the food be properly prepared. Finish off fattening pigs ready for sale; for treatment of others progressing *see* previous months; and do not neglect regular brushing of their hides.

MAY.

Put the sow to the boar for the second and regular farrowing of the season. Attend to farrow sows and young pigs—*see* last month. Give store pigs and those put up for fattening feeds of such green forage food as may be sufficiently advanced for cutting, such as tares, rye, &c., with potatoes and roots to form the bulk of their food. Give young pigs after being weaned feeds of dairy produce mixed with meals of various kinds.

JUNE.

Attend to sows about to farrow and to those which have litters, details of treatment of which will be found under March. Give store pigs green cut food in their yards, which should be supplied with abundant litter so as to produce lots of manure, and keep pushing them on progressively into good condition for being drafted into the fattening sties. Provide a small field near the steading in which pigs can be put for some hours a day, avoiding their exposure to strong sun, which blisters and inflames their hides.

JULY.

Store pigs will be easily fed and managed this month, as green foods of various kinds should be abundant, this being nearly all they require, except the occasional feed, if not a daily one, of some more solid or nutritious food, for which *see* last month. Feed weaned pigs liberally, as also sows with farrows. *See* previous months.

AUGUST.

Store pigs may be either turned out to the stubbles of corn fields which are harvested, or fed in yards, as some prefer, for the more economical saving of their manure; if the latter, they must be fed on cut forage food, brewers' and distillers' wash being used in preference to dairy refuse, which it will be more economical to store up for the coming winter months, when it will be scarcer than now. In both cases the store pigs should have sold food, as stated in last month, for which also see as to young pigs and sows with litters.

SEPTEMBER.

Finish off fattening pigs within three weeks of sale with oatmeal and maize. Store pigs should all be fed in yards, excepting those which the farmer may desire to put out to any stubble-field, with cut green food, such as vetches or clover, and the refuse of green crops, such as roots which have run to seed, &c. &c. Feed with nutritious food fattening pigs. For treatment of young pigs, sows about to litter, *see* last month. Prepare for the winter months all sties, cleaning them thoroughly out and making them, as sailors say, "snug," or, as housekeepers, "in apple-pie order."

POULTRY CALENDAR.

OCTOBER.

Clean out thoroughly the hen-houses, &c., and repair all fittings out of order. Take up the old and lay down new floors, if of earth, and make and put everything in order for the coming winter months. Where the erections are extensive, and special heating apparatus be applied to them, see that it be in good repair, so that it may not be found in bad working order when wanted in cold weather; if such be not provided, and a continuity of egg-laying be desired, it will be worth while to fit up one or other of the numerous forms of simple heating-stoves which can now be easily had; or, failing these, an old-fashioned iron stove, which will cost but a few shillings, will be better than nothing in the way of artificial heating. If this be used, take care that it is so arranged as to prevent sulphurous fumes or smoke from filling the hen-house. Failing the carrying out of even this last simple method of obtaining the necessary warmth, if there be more houses than one, draft the poultry from the thinly filled ones into one which will be well stocked, the fowls being thus more comfortably warm than when a few only are together. Pay attention to the prevention of damp, looking specially to the condition of the roof, that no drip be coming through it. Select the birds to be fattened for the Christmas market and succeeding months of winter and early spring; also those which are intended to lay for the same period, when high prices are obtained; and likewise those adapted for bringing up broods, or as nursing mothers, whether of chickens or ducklings. The labours of the month will be comprised in attending to these three classes, and in the daily regular cleaning out of the houses and water-troughs, &c., &c. Feed regularly and frequently, the latter more especially, as the cold weather increases. For details of food and feeding *see* text.

NOVEMBER.

The work of this month is still more easy than that of the last, being confined chiefly to keeping the houses in order,

and maintaining and regulating the proper degree of warmth —60° Fah., or a little over; but the poultry will not quarrel with a considerably higher temperature. Do not forget that poultry came originally from tropical climates; on this hint act. Pay special attention to the birds set aside for fattening, arranging them as to age and condition, so that they will come in ready for market in a series or successional order. For the best fattening foods, time, and method of giving them, *see* text.

DECEMBER.

The fattening of the birds set aside for Christmas market must now receive its last stage, so that the birds will be finished off in as plump and saleable a condition as possible. Avoid feeding which gives flabbily fed birds, aiming at having the flesh firm, evenly laid on, and of the white colour so much esteemed at table. To fatten quickly the birds should be confined in a small warm room, to which a very little light is admitted, and the last stage of what may be called extreme fattening should not exceed twelve or fourteen days, extra fattened fowls being liable to inflammation and other complaints. Where cramming is adopted for fattening the birds, the food given (for which *see* text) should be in one meal a day, this being as much as can be forced into the bird; attend to the condition of other classes of birds, feeding them regularly with warm food made up in a thickish or pasty condition, with which in very cold weather a little cayenne pepper may be mixed. Good clean kitchen stuff, scraps of meat, &c., may be given with advantage to the fowls. Meaty bones will engage their attention for many an hour, and will form, moreover, nutritious food. See to the supply of clean water and of old mortar, egg-shells, gravel, or sand, for the fowls to peck at.

JANUARY.

Feed fattening fowls frequently, finishing them off for market, as explained in last month and in next. The white flesh so much desired by purchasers will generally be secured by giving them drinks of milk in which rice has been boiled, the rice itself being used as a solid food along with other kinds. See to the condition of the houses, the supply of water and other necessaries. Comparatively few hens will

be laying now as a general rule, but much depends upon the breed, Cochins and Brahmas laying best, the Spanish breed being also good winter layers. The great point to be aimed at is to keep the birds in a warm and thoroughly dry house, on food calculated to maintain the heat of the body, and the giving of it regularly. Oats are excellent food, and should be given the birds before roosting. Another point is keeping the birds free from vermin, for which purpose keep the dust-baths thoroughly supplied with dust; change frequently the materials of which their nests are composed; fumigate the houses when empty with brimstone, and sprinkle a little of the flour of sulphur in their nests. To keep up the succession of broods *see* text; hens selected for setting should be induced to become broody for the end of the month for the earliest hatches.

FEBRUARY.

For treatment of fattening fowls and laying hens, *see* last month. Prepare nests for broody hens; set them in quiet places, and to those who begin to sit pay particular attention to their supply of food and water. If soft food be given them, as a rule dry grains should be added, oats being by far the best. Let the sitting hens have access for half an hour at the most daily to a place in which there is a dust-bath and a supply of old mortar at which they can peck.

MARCH.

The hard work of the poultry-yard may be said to commence this month, hens becoming fast broody, and towards the end of it several hatches may be expected. For all the details connected with the setting of hens, the feeding and care of chickens, *see* text. For those connected with fattening fowls and laying hens, *see* previous months. In setting ducks' eggs for hatches, the broods of which are to be reared for sale as food, select those that are the produce of Aylesbury bucks and Rouen drakes. Early broods of turkeys will require the most careful treatment both as to feeding and housing, warmth being essential. The male bird must not have access to them. Goslings are much more easily reared; they may be left to the care of the geese; geese are excellent careful mothers. They must have access to a pond and a run of grass.

APRIL.

The work of this month is chiefly connected with the care of broody hens and young chickens; the latter must be carefully looked after. See to laying hens, which will be now laying abundantly. Set turkeys with eggs, not exceeding fifteen in number, for the birds' earlier hatches (*see* last month). Feed young goslings with soft food, and let ducks of the first hatch have access to the pond. See to the supply of food, which if properly attended to will make them ready for sale at least by the end of next month.

MAY.

The work of this month so closely resembles that for last month, that little needs be said in addition to what was given under that head. Attend carefully to sitting hens, chickens when first hatched, and those of the earlier broods to be kept, regularly increasing in good condition.

JUNE.

The chickens of the earliest brood being nearly ready for market, set them up in coops for the last fortnight before despatching them for the market, in order to finish them off with abundant supplies of fattening food. Select from the broods the best birds from which to rear broods. As a great variety of foods can now be obtained, keep changing the systems of feeding for all classes of poultry, so as to have them as varied as possible.

JULY.

Where good grass-runs are provided for the birds of all classes, especially if they have access to fields, they will almost keep themselves; but even in such circumstances give them morning and evening feeds in the yard, oats and beans being the evening food, which will bring them home to roost in good time. Select from the chickens the birds intended to be kept for purposes named under the head January, which see. For laying eggs for sale the Spanish are the best. The Dorkings are good mothers, and the Cochins are good both for sitting and nursing, and are capital winter layers. A cross between the Dorking and the Spanish makes an excellent bird for sale as food.

AUGUST.

The remarks made last month will apply almost to this. Eggs being abundant and cheap, preserve numbers for family use and for winter sale, but as preserved eggs only. For methods of preserving *see* text. Continue the selection of breeds as in last month. Sell off or kill the cockrels, keeping the best for breeding purposes at the rate of one bird to six or eight hens.

SEPTEMBER.

Sell off cockrels of the later batches as are in good enough condition, as also pullets which are not designed to be kept. Continue to preserve eggs, and to collect, arrange, and set aside for domestic use feathers of such birds as have been plucked and dressed before being sold. Begin to prepare for the winter months.

INDEX.

Appliances of the farm, 317
Arable, conversion of, into meadow land, 24
Arable land on milk farms, 22
Artichoke, Jerusalem, 298
Auxiliary farm, cottages of the, 325
Auxiliary farms, implements for, 315

Beans, cultivation of, 305
Beasts fattening for the butcher, policy of considering dairy cows, 66
Bedding materials for stock, 118
Beetroot, 280
  preparation of land for, 281
  storing of, 284
  weeding of, 282
Beetroot culture and harvesting, 283
Breeds of milch cows, selection of, 75
Buildings of the farm, 321
Butter-making, 73

Cabbages, 285
  preparation of land for, 287
  proper soil for, 286
  and artichokes, storing of, 299
  as food for store pigs, 288
Calf food, constituents of, 83
  treatment and general management of the, 79
Calves, artificial foods for, 85
  instructions for feeding of, 82
  natural and hand-feeding of, 81
  solid food for, 86
Calves, summer management of, 87
Carrots, 290
  varieties of, 291
Cattle, 310
  food, preparation of, by steaming vats, 58
Changes in cattle food, cautions respecting, 121
Cheese, manufactory, of in factories, 137
Cheese-factory system, statistics of, 138
Cheese-making, 73
Chickens, first food for, 251
Cleanliness of vessels in which animals are fed, 119
Cock, Cochin China, the, 256
  and hen, domestic, as human food, 203
  varieties of, 202
Cottage accommodation for labourers, 335
  good, importance of, 329
  points connected with, 327
  detached for labourers, 330, 332
  outbuildings and elevation of, 333
Cottages of the auxiliary farm, 325
  plan of, 331
  semi-detached, 334
Cow, dairy, indications of the value of, by the udder, &c., 71
Cow, good points of a, 69
  udder of, description of, 72
Cows and pasture lands, treatment of, 17
  cattle, and pigs, 311

Cows, dairy, breeds, and selection of, 63
dairy, food for, 19
dairy, milking capabilities of, 68
dairy, relative milking capabilities of, 76
feeding of, in pastures, 122
for dairy purposes, selection of, 64
general feeding and pasturage of, 89
in calf, management of, 123
in calf, abortion of, 123
in calf, food and water for, 125
in calf, plants injurious to, 127
influenced by their food and physical and physiological peculiarities, 68
milch, choice and peculiarities of breed of, 60
milking capabilities of, the scutcheon or escutcheon indicative of, 70
milking, properties of points influencing, 67
milk veins of, 73
peculiarities of milk of, 73
selection of to breed from, 75
summer provision for, 90
Yorkshire breed of, 61
Cowsheds, steaming-house, yard, &c., plan of, 58
Crops, culture of, 295
preparation for, 296
quick successive, for dairy farms, 34
rotation of, 262
second, cautions to be observed, 27
Culture of the kohl rabi, 297

Dairy, cleanliness essential in, 106
Dairy cow, value of, indications of, 71
Dairy cows, 73
as fattening beasts, policy of, 66
breeds and selection of, 63
Dairy cows, disadvantage of buying in open market, 74
food for, 19
general care and management of, 112
leading points in selection of, 65
milking capabilities of, influenced by food, 68
pasturing and soiling, 121
points influencing milking properties, 67
relative milking capabilities of the herd of, 76
variation in quality, and peculiarities of the milk of, 73
Dairy farming, examples of, 14
Dairy farms, see houses for, 102
increasing forage crops for, 32
Dairyman's Association, 133
Dairy practice, factory system of, 132
Dairy purposes, cows to be selected for, 64
Dairy stock, advantages of breeding and clearing on dairy farm, 74
housing and sheltering of, 113
Duck, the, 205
Ducks, 313
food for, 207
setting of, 206
young, treatment of, 208
Dwelling-houses for milk farms, plans of, 48 to 52

Eggs, chemical composition of, 204
preservation of, 217
for setting, number of, 249
supply of, to keep up, 239
various methods of keeping, 218

Factory system in dairies in Great Britain, 132
of dairying, objections to considered, 134
Farm animals, housing accommodation for, 162

Farm buildings and cottages, effects of providing, 336
Farm, buildings of the, 321
dwelling-houses, plans of, 147—150
fences of the, 318
gate fastenings, 320
gates, hedges, and fences, 319
Farmhouse, chamber plan of, 324
plan of a two-storied, 323
improvements, 260
labourers' cottages, description of, 328
lands, improvement of, 7
live stock of the, 308
produce, attention to the production of, 260
road, fences, gates, &c., 317
stock, attention to health of, 116
Farmhouses, points of, 309
Farmery cowsheds, description of, 56
or steading of houses, 55
steaming apparatus for the preparation of food, 57
Farming companies, 129
suburban, Introduction, 1
Farms, auxiliary, points to be attended to, 259
Farms, for milk, size, &c., of, 18
milk, delivery of the milk of, 91
Feeding and pasturage of cows, general, 89
of calves, 81
Food of cows, its peculiar physical and physiological influence, 68
preparation of, for cattle, by steaming apparatus, 57
Foods, vegetable, for pigs and poultry, 143
Fowls, barn-door, 252
Dorking, 253
Polish, 254
Spanish, 255
Fungi propagation, 110

Garden, the kitchen, 42
Gates, 319
Geese, 209, 318
Geese and ducks, treatment of, 221
as human food, 211
hatching of, 210
Grains, pease, and beans, 301
Grasses, seeding down of, 26
Grass farm, portion for, for domestic purposes, 40
land, top dressings, 11
Green crops, or forage, increase of, 30
food and roots for dairy cows, 21

Hatches, good, how to secure, 247
Hens, broody, management of, 244
nest for, 245
setting, food for, 246
Herd of dairy cows, relative milking capabilities of, 76
Home-grown food, importance of, 33
Horses, farm, points of, 309

Implements and machines, 314
for auxiliary farms, 315

Kitchen garden, the, 43
Kohl rabi, 293
for dairy stock, 294

Labourer's cottage, accommodation for, 335
cottages and perquisites, 151
cottages, plans of, 153
on farms, treatment of, 155
Land for pig and poultry farms, 141
necessity of highest culture of, 145
waste pieces, cultivation of, 36
Lime, application of, 269
Liming of soils, 9
Live stock of the farm, 308

Machines and implements, 314
Meadow grass, over-ripe, loss sustained by, 28
Meadows, general management of, 24
Milch cows, breed and peculiarities of, 60

Milch cows, description of best, 62
Milk and arable farms, conjunction of, 30
Milk, 73
adulteration of, 97
and water, mixing of, 96
putridity of, cause of, 111
delivery of, 95
fermentation, 99
iced water for cooling, 101
taste and flavour of, 300
testing the qualities of, 77
transportation of, 101
veins of cows, 73
farms, 7
farms, arable land on, 93
farms, buildings for, 48
farms, capital required in, 104
farms, cottages for, 53
farms, delivery of the milk of, 91
farms, plans of the dwelling-houses of, 49
farms, size, extent, cropping, &c., 18
farms, suburban, working of, 129
Milk-cooling, improvements in, 99
Milking capabilities of cows, the scutcheon or escutcheon indicating, 70
properties of cows, points influencing, 67
properties, points influencing, 67

Oats, 302
Outbuildings and elevation of cottage, 333

Parsnip, the, 292
Pasturage of cows, general, 89
Pease, 306
Pig and poultry farms, 140
Pig-breeding, instructions for, 190
points to be attended to, 179
farming, summary of, 189
fattening, 199
feeding and management, details of, 197
Pig-feeding, general management of, 196
food, home grown, 195
value of as a farm animal, 181
Pigs, 311
accommodation for, 182
accommodation for various classes of, 165
and poultry, accommodation for, 163
and the piggery, management of, 191
as producers of manure, 171
breeding of, 157
breed of, recommended, 177
breeds of, 159
cleanliness of, 193
cleanly habits of, 167
colour and size of, 161
cooked food for fattening, 180
diseases of, 187
food and feeding of, 194
green food for, 304
on dairy farms and in cottages, 183
overlaying of farrow, to prevent, 198
pease as food for, 307
points to be aimed at in feeding of, 169
shelter-sheds and water supply for, 173
slaughtering of, on the farm, 189
their points and peculiarities, 157
weight and bulk of, 188
yard and paddock for, 199
young, sties for rearing, 164
Piggeries, plan of, 166
Piggery, circular plan of, 175
for a farm of 200 acres, plan of, 167
section of a, 168
Points, general, respecting milch cows, 63
Pork, bacon, &c., nutritive value of, 184
Pork, curing for bacon, &c., 186

Pork, price and dressing of, for sale, 185
Potato, culture and harvesting of, 277
Potatoes, 272
advantages of, as a crop, 279
as food for pigs, &c., 142
culture of, 275
earthing up of, 276
planting of, 274
preparation of land for, 273
Poultry, 201, 312
and pigs, breeding, rearing, &c., 142
and pigs, farms, 140
careful feeding of, 237
Cochin China hen, the, 257
cooking and roosting houses for, 220
cooking-house, description of, 227
cramming of, 241
effects of proper treatment of, on, 224
farm accommodation for, 225
farm, proportions and arrangements of, for, 226
fattened for the table, 242
food for, 222
food for fattening, 243
food, preparation of, 235
general management of, 230
heated houses for, 223
house accommodation, plan for, 228
housing and shelter of, 231
materials for, 233
meals for, 236
of various kinds, comparative value of, 216
warmth and feeding essential for, 219
warmth necessary for, 232

Qualities of milk, testing the, 77

Root crops for feeding purposes, 289
preparation for, 265
Root crops, production of, 263
sowing of, 267
Roots and green food for dairy cows, 21

Seeding down of grasses, 26
Skin and coat of stock, care of, 117
Soils, deep culture of, 44
liming of, 9
Spade-digging, 41
on pig and poultry farms, 144
Spangled Hamburg fowls, 255
Stock, dairy, breeding and rearing on farm, advantage of, 74
pasturing upon meadow land 27
Suburban Farming, Introduction to, 1
Summer provision for cows, 90
Swine, improvement in the breed of, 158

Testing qualities of milk, 77
Turkeys, 212, 313
generic character of, 213
hatching of, 214
flesh and eggs as human food, 215

Udder of the cow, description of 72

Valuation of milk farms, 131
Vetches, 303

Waste pieces of land, cultivation of, 36
Winter, evil of exposing animals in, 115
Wood vessels, defects of, in the dairy, 107
vessels for the dairy, 106
Wooden dairy vessels, cleaning of, 109

Yorkshire breed of cows, 61

PRINTED BY VIRTUE AND CO., LIMITED, CITY ROAD, LONDON.

STANDARD AGRICULTURAL WORKS.

LANDED ESTATES MANAGEMENT: Treating of the Varieties of Lands on the Estate, Peculiarities of its Farms, Methods of Farming, Construction of Roads, Fences, Gates, and Farm Buildings, Irrigation, Drainage, Plantation, &c. By R. SCOTT BURN, Author of "Outlines of Modern Farming," &c. Fcap. 8vo, numerous Illustrations, 3s. 6d. [*Now ready.*

"A very useful *vade mecum* to such as have the care of land. The author shows himself practically acquainted with his subject in all its main branches, and most of his suggestions seem to be well worthy of consideration. It is a work upon the writing of which great care has evidently been bestowed, and which contains a deal of solid information."—*Globe.*

"In this handy volume we are presented with a complete and comprehensive outline of the duties appertaining to the management of landed estates, and the various operations necessary to be performed under that department of rural industry; the whole being conveyed in such clear and concise language that the appearance of the book will be hailed as a great boon by the numerous and influential class interested in the profitable and judicious management of landed property, and who have not had, up to the present time, any really useful "handy" book treating upon their multifarious duties in a concise and intelligent way, and which they can conveniently carry in their pocket and refer to when going about in the performance of their duties."—*Journal of Forestry.*

THE LESSONS OF MY FARM: a Book for Amateur Agriculturists, being an Introduction to Farm Practice, in the Culture of Crops, the Feeding of Cattle, Management of the Dairy, Poultry, and Pigs, and in the Keeping of Farm-work Records. By ROBERT SCOTT BURN. With numerous Illus. Fcap., 6s. cloth.

"A most complete introduction to the whole round of farming practice."—*John Bull.*

OUTLINES OF MODERN FARMING. By R. SCOTT BURN. Soils, Manures, and Crops—Farming and Farming Economy, Historical and Practical—Cattle, Sheep, and Horses—Management of the Dairy, Pigs, and Poultry, with Notes on the Diseases of Stock—Utilisation of Town Sewage, Irrigation, and Reclamation of Waste Land. New Edition. 1,250 pp., half-bound, profusely Illustrated, 12s.

"There is sufficient stated within the limits of this treatise to prevent a farmer from going far wrong in any of his operations."

THE COMPLETE GRAZIER AND FARMER'S AND CATTLE BREEDER'S ASSISTANT. A Compendium of Husbandry. By WILLIAM YOUATT, Esq., V.S. 12th Edition, much enlarged by ROBERT SCOTT BURN, Author of "The Lessons of My Farm," &c. In one handsome volume, 8vo, numerous Illustrations, £1 1s., strongly half-bound. [*Just published.*

"A treatise which will remain a standard work on the subject as long as British agriculture endures."—*Mark Lane Express.*

FRUIT TREES: THE SCIENTIFIC AND PRO- FITABLE CULTURE OF. Including Choice of Trees, Planting, Grafting, Training, Restoration of Unfruitful Trees, Gathering and Preservation of Fruit, &c. From the French of M. DU BREUIL, Professor of Arboriculture in the Conservatoire Impérial des Arts et Métiers. Third Edition, carefully revised, with an Introduction by G. GLENNY. With 187 Woodcuts, 12mo, cl., 4s. 6d.

"The book teaches how to prune and train fruit trees to perfection."—*Field.*

LONDON: CROSBY LOCKWOOD & CO., 7, STATIONERS' HALL COURT, E.C.

STANDARD AGRICULTURAL WORKS.

THE LAND IMPROVER'S POCKET-BOOK OF FORMULÆ, TABLES, and MEMORANDA, required in any Computation relating to the Permanent Improvement of Landed Property. By JOHN EWART, Land Surveyor and Agricultural Engineer. Rl. 32mo, oblong, leather, gilt edges, elastic band, 4s.

"It is admirably calculated to serve the purpose for which it was intended."—*Scotsman.*

"A compendious and handy little volume."—*Spectator.*

THE LAND VALUER'S BEST ASSISTANT: being Tables, on a very much improved Plan, for Calculating the Value of Estates. To which are added, Tables for reducing Scotch, Irish, and Provincial Customary Acres to Statute Measure; also, Tables of Square Measure, and of the various Dimensions of an Acre in Perches and Yards, by which the Contents of any Plot of Ground may be ascertained without the expense of a regular Survey, &c. By R. HUDSON, C.E. New Edition, royal 32mo, oblong, leather, gilt edges, with elastic band, 4s.

"Of incalculable value to the country gentleman and professional man."—*Farmer's Journal.*

THE LAND VALUER'S AND LAND IMPROVER'S COMPLETE POCKET-BOOK; consisting of the above two works bound together, leather, gilt edges, with strap, 7s. 6d.

☞ *The above forms an unequalled and most compendious Pocket Vademecum for the Land Agent and Agricultural Engineer.*

"We consider Hudson's book to be the best ready-reckoner on matters relating to the valuation of land and crops we have ever seen, and its combination with Mr. Ewart's work greatly enhances the value and usefulness of the latter-mentioned. . . . It is most useful as a manual for reference to those for whom it is intended."—*North of England Farmer.*

SHEEP: THE HISTORY, STRUCTURE, ECONOMY, AND DISEASES OF. By W. C. SPOONER, M.R.V.C., &c. Third Edition, considerably enlarged, with numerous fine engravings, including some specimens of New and Improved Breeds. Fcap. 8vo, 336 pp., 6s. cloth.

"The book is decidedly the best of the kind in our language."—*Scotsman.*

"Mr. Spooner has conferred upon the agricultural class a lasting benefit by embodying in this work the improvements made in sheep stock by such men as Humphreys, Rawlence, Howard, and others."—*Hampshire Advertiser.*

"The work should be in possession of every flockmaster."—*Banbury Guardian.*

AGRICULTURAL ENGINEERING: Farm Buildings, Motive Powers and Machinery of the Steading, Field Machines, and Implements. By G. H. ANDREWS. 12mo, Illustrated, 3s.

CLAY LANDS AND LOAMY SOILS. By Professor DONALDSON. 12mo, 1s.

READY-RECKONER FOR THE ADMEASUREMENT OF LAND. By ABRAHAM ARMAN, Schoolmaster, Thurleigh, Beds. To which is added a Table showing the Price of Work from 2s. 6d. to £1 per acre, and Tables for the Valuation of Land from 1s. to £1,000 per acre, and from one pole to two thousand acres in extent, &c., &c. 12mo, 1s. 6d.

LONDON: CROSBY LOCKWOOD & CO., 7, STATIONERS' HALL COURT, E.C.

Just published, crown 8vo, handsomely bound in Cloth, with Frontispiece and numerous Illustrations, price 5s.

A PLAIN GUIDE TO

GOOD GARDENING;

OR, HOW TO GROW VEGETABLES, FRUIT, AND FLOWERS,

WITH PRACTICAL NOTES ON SOILS, MANURES, SEEDS, PLANTING, LAYING-OUT OF GARDENS AND GROUNDS, AND ON THE VARIOUS KINDS OF GARDEN STRUCTURES.

By SAMUEL WOOD,

AUTHOR OF "MULTUM-IN-PARVO GARDENING," ETC.

SECOND EDITION, WITH VERY CONSIDERABLE ADDITIONS AND NUMEROUS ILLUSTRATIONS.

SUMMARY OF CONTENTS.

The Kitchen Garden—The Flower Garden—The American Garden—The Italian Garden—The Dutch Garden—The Rosary—The Wilderness and Rockeries, and how to Make them—Plants suited for Sunny and Shady Windows—The Choice of Plants for Exhibition, and how to Grow them—Soils, Digging, Trenching, Raking, Hoeing, Manures and Manuring, Rotation of Crops—Garden Structures—Laying out of the Garden—How to Choose, how to Preserve, and how to Sow Seeds—Planting, Transplanting, Weeding—Protecting Plants against Frost—The Gardener's Enemies, and how to Destroy them—List of Technical Terms, &c.

"We may very safely commend Mr. Wood's book to all those who aspire to really good gardening, being satisfied that its principles are sound and its directions practical, and that those who take it for their manual will be in no danger whatever of being led astray."—*Spectator.*

"Written by a practical man, and gives practical instructions which it is easy to understand."—*Saturday Review.*

Also by the same Author, Crown 8vo, cloth, with numerous Illutsrations, price 2s.

MULTUM-IN-PARVO GARDENING.

Showing how to make One Acre of Land, without Glass, produce, by the Cultivation of Fruits and Vegetables, £620 per annum; and how to Grow Flowers in Three Glass-houses so as to realise £176 per annum Clear Profit, &c., &c. [*Just published.*

LONDON: CROSBY LOCKWOOD & CO., 7, STATIONERS' HALL COURT, E.C.

LONDON, *August*, 1877.

A Catalogue of Books

INCLUDING MANY

NEW & STANDARD WORKS

IN

ENGINEERING, ARCHITECTURE, AGRICULTURE, MATHEMATICS, MECHANICS, SCIENCE, &c. &c.

PUBLISHED BY

CROSBY LOCKWOOD & CO.,

7, STATIONERS'-HALL COURT, LUDGATE HILL, E.C.

ENGINEERING, SURVEYING, &c.

Humber's New Work on Water-Supply.

A COMPREHENSIVE TREATISE on the WATER-SUPPLY of CITIES and TOWNS. By WILLIAM HUMBER, Assoc. Inst. C.E., and M. Inst. M.E. Author of "Cast and Wrought Iron Bridge Construction," &c. &c. Imp. 4to. Illustrated with 50 Double Plates, 2 Single Plates, Coloured Frontispiece, and upwards of 250 Woodcuts, and containing 400 pages of Text, elegantly and substantially half-bound in morocco. Price 6*l.* 6*s.*

List of Contents:—

I. Historical Sketch of some of the means that have been adopted for the Supply of Water to Cities and Towns.—II. Water and the Foreign Matter usually associated with it.—III. Rainfall and Evaporation.—IV. Springs and the water-bearing formations of various districts.—V. Measurement and Estimation of the Flow of Water.—VI. On the Selection of the Source of Supply.—VII. Wells.—VIII. Reservoirs.—IX. The Purification of Water.—X. Pumps.—XI. Pumping Machinery.—XII. Conduits.—XIII. Distribution of Water.—XIV. Meters, Service Pipes, and House Fittings.—XV. The Law and Economy of Water Works.—XVI. Constant and Intermittent Supply.—XVII. Description of Plates.—Appendices, giving Tables of Rates of Supply, Velocities, &c. &c., together with Specifications of several Works illustrated, among which will be found:—Aberdeen, Bideford, Canterbury, Dundee, Halifax, Lambeth, Rotherham, Dublin, and others.

OPINIONS OF THE PRESS.

"The most systematic and valuable work upon water supply hitherto produced in English, or in any other language."—*Engineer* (first notice, Nov. 3. 1876.

"Mr. Humber's work is characterised almost throughout by an exhaustiveness much more distinctive of French and German than of English technical treatises."—*Engineer* (third notice), Dec. 15, 1876.

"We can congratulate Mr. Humber on having been able to give so large an amount of information on a subject so important as the water supply of cities and towns. The plates, fifty in number, are mostly drawings of executed works, and alone would have commanded the attention of every engineer whose practice may lie in this branch of the profession."—*Builder*, Dec. 9, 1876.

Humber's Modern Engineering. First Series.

A RECORD of the PROGRESS of MODERN ENGINEERING, 1863. Comprising Civil, Mechanical, Marine, Hydraulic, Railway, Bridge, and other Engineering Works, &c. By WILLIAM HUMBER, Assoc. Inst. C.E., &c. Imp. 4to, with 36 Double Plates, drawn to a large scale, and Photographic Portrait of John Hawkshaw, C.E., F.R.S., &c. Price 3*l.* 3*s.* half morocco.

List of the Plates.

NAME AND DESCRIPTION.	PLATES.	NAME OF ENGINEER.
Victoria Station and Roof—L. B. & S. C. Rail.	1 to 8	Mr. R. Jacomb Hood, C.E.
Southport Pier	9 and 10	Mr. James Brunlees, C.E.
Victoria Station and Roof—L. C. & D. & G. W. Railways	11 to 15A	Mr. John Fowler, C.E.
Roof of Cremorne Music Hall	16	Mr. William Humber, C.E.
Bridge over G. N. Railway	17	Mr. Joseph Cubitt, C.E.
Roof of Station—Dutch Rhenish Railway	18 and 19	Mr. Euschedi, C.E.
Bridge over the Thames—West London Extension Railway	20 to 24	Mr. William Baker, C.E.
Armour Plates	25	Mr. James Chalmers, C.E.
Suspension Bridge, Thames	26 to 29	Mr. Peter W. Barlow, C.E.
The Allen Engine	30	Mr. G. T. Porter, M.E.
Suspension Bridge, Avon	31 to 33	Mr. John Hawkshaw, C.E. and W. H. Barlow, C.E.
Underground Railway	34 to 36	Mr. John Fowler, C.E.

With copious Descriptive Letterpress, Specifications, &c.

"Handsomely lithographed and printed. It will find favour with many who desire to preserve in a permanent form copies of the plans and specifications prepared for the guidance of the contractors for many important engineering works."—*Engineer.*

Humber's Modern Engineering. Second Series.

A RECORD of the PROGRESS of MODERN ENGINEERING, 1864; with Photographic Portrait of Robert Stephenson, C.E., M.P., F.R.S., &c. Price 3*l.* 3*s.* half morocco.

List of the Plates.

NAME AND DESCRIPTION.	PLATES.	NAME OF ENGINEER.
Birkenhead Docks, Low Water Basin	1 to 15	Mr. G. F. Lyster, C.E.
Charing Cross Station Roof—C. C. Railway.	16 to 18	Mr. Hawkshaw, C.E.
Digswell Viaduct—Great Northern Railway.	19	Mr. J. Cubitt, C.E.
Robbery Wood Viaduct—Great N. Railway.	20	Mr. J. Cubitt, C.E.
Iron Permanent Way	20a	
Clydach Viaduct—Merthyr, Tredegar, and Abergavenny Railway	21	Mr. Gardner, C.E.
Ebbw Viaduct ditto ditto ditto	22	Mr. Gardner, C.E.
College Wood Viaduct—Cornwall Railway	23	Mr. Brunel.
Dublin Winter Palace Roof	24 to 26	Messrs. Ordish & Le Feuvre
Bridge over the Thames—L. C. & D. Railw.	27 to 32	Mr. J. Cubitt, C.E.
Albert Harbour, Greenock	33 to 36	Messrs. Bell & Miller.

With copious Descriptive Letterpress, Specifications, &c.

"A *résumé* of all the more interesting and important works lately completed in Great Britain; and containing, as it does, carefully executed drawings, with full working details, it will be found a valuable accessory to the profession at large."—*Engineer.*

"Mr. Humber has done the profession good and true service, by the fine collection of examples he has here brought before the profession and the public."—*Practical Mechanics' Journal.*

Humber's Modern Engineering. Third Series.

A RECORD of the PROGRESS of MODERN ENGINEERING, 1865. Imp. 4to, with 40 Double Plates, drawn to a large scale, and Photo Portrait of J. R. M'Clean, Esq., late President of the Institution of Civil Engineers. Price 3*l.* 3*s.* half morocco.

List of Plates and Diagrams.

MAIN DRAINAGE, METROPOLIS, NORTH SIDE.

Plate 1. Map showing Interception of Sewers.—2 and 3. Middle Level Sewer. Sewer under Regent's Canal; and Junction with Fleet Ditch.—4, 5, and 6. Outfall Sewer. Bridge over River Lea. Elevation and Details.—7. Outfall Sewer. Bridge over Marsh Lane, North Woolwich Railway, and Bow and Barking Railway Junction.—8, 9, and 10. Outfall Sewer. Bridge over Bow and Barking Railway. Elevation and Details.—11 and 12. Outfall Sewer. Bridge over East London Waterworks' Feeder. Elevation and Details.—13 and 14. Outfall Sewer. Reservoir. Plan and Section.—15. Outfall Sewer. Tumbling Bay and Outlet.—16. Outfall Sewer. Penstocks.

SOUTH SIDE.

Plates 17 and 18. Outfall Sewer. Bermondsey Branch.—19, 20, 21, and 22.

MAIN DRAINAGE, METROPOLIS, *continued*—

Outfall Sewer. Reservoir and Outlet. Plan and Details.—23. Outfall Sewer. Filth Hoist.—24. Sections of Sewers (North and South Sides).

THAMES EMBANKMENT.

Plate 25. Section of River Wall.—26 and 27. Steam-boat Pier, Westminster. Elevation and Details.—28. Landing Stairs between Charing Cross and Waterloo Bridges.—29 and 30. York Gate. Front Elevation. Side Elevation and Details.—31, 32, and 33. Overflow and Outlet at Savoy Street Sewer. Details; and Penstock.—34, 35, and 36. Steam-boat Pier, Waterloo Bridge. Elevation and Details.—37. Junction of Sewers. Plans and Sections.—38. Gullies. Plans and Sections.—39. Rolling Stock.—40. Granite and Iron Forts.

With copious Descriptive Letterpress, &c.

Humber's Modern Engineering. Fourth Series.

A RECORD of the PROGRESS of MODERN ENGINEERING, 1866. Imp. 4to, with 36 Double Plates, drawn to a large scale, and Photographic Portrait of John Fowler, Esq., President of the Institution of Civil Engineers. Price 3*l.* 3*s.* half morocco.

List of the Plates and Diagrams.

NAME AND DESCRIPTION.	PLATES.	NAME OF ENGINEER.
Abbey Mills Pumping Station, Main Drainage, Metropolis	1 to 4	Mr. Bazalgette, C.E.
Barrow Docks	5 to 9	Messrs. M'Clean & Stillman, [C.E.
Manquis Viaduct, Santiago and Valparaiso Railway	10, 11	Mr. W. Loyd, C.E.
Adams' Locomotive, St. Helen's Canal Railw.	12, 13	Mr. H. Cross, C.E.
Cannon Street Station Roof	14 to 16	Mr. J. Hawkshaw, C.E.
Road Bridge over the River Moka	17, 18	Mr. H. Wakefield, C.E.
Telegraphic Apparatus for Mesopotamia	19	Mr. Siemens, C.E.
Viaduct over the River Wye, Midland Railw.	20 to 22	Mr. W. H. Barlow, C.E.
St. Germans Viaduct, Cornwall Railway	23, 24	Mr. Brunel, C.E.
Wrought-Iron Cylinder for Diving Bell	25	Mr. J. Coode, C.E.
Millwall Docks	26 to 31	Messrs. J. Fowler, C.E., and William Wilson, C.E.
Milroy's Patent Excavator	32	Mr. Milroy, C.E.
Metropolitan District Railway	33 to 38	Mr. J. Fowler, and Mr. T. M. Johnson, C.E.
Harbours, Ports, and Breakwaters	A to C	

With Copious Descriptive Letterpress, Specifications, &c.

Humber's Great Work on Bridge Construction.

A COMPLETE and PRACTICAL TREATISE on CAST and WROUGHT-IRON BRIDGE CONSTRUCTION, including Iron Foundations. In Three Parts—Theoretical, Practical, and Descriptive. By WILLIAM HUMBER, Assoc. Inst. C.E., and M. Inst. M.E. Third Edition, revised and much improved, with 115 Double Plates (20 of which now first appear in this edition), and numerous additions to the Text. In 2 vols. imp. 4to, price 6*l.* 16*s.* 6*d.* half-bound in morocco.

"A very valuable contribution to the standard literature of civil engineering. In addition to elevations, plans, and sections, large scale details are given, which very much enhance the instructive worth of these illustrations. No engineer would willingly be without so valuable a fund of information."—*Civil Engineer and Architect's Journal.*

"Mr. Humber's stately volumes lately issued—in which the most important bridges erected during the last five years, under the direction of our most eminent engineers, are drawn and specified in great detail."—*Engineer.*

"A book—and particularly a large and costly treatise like Mr. Humber's—which has reached its third edition may certainly be said to have established its own reputation."—*Engineering.*

Strains, Formulæ & Diagrams for Calculation of.

A HANDY BOOK for the CALCULATION of STRAINS in GIRDERS and SIMILAR STRUCTURES, and their STRENGTH; consisting of Formulæ and Corresponding Diagrams, with numerous Details for Practical Application, &c. By WILLIAM HUMBER, Assoc. Inst. C.E., &c. Second Edition. Fcap. 8vo, with nearly 100 Woodcuts and 3 Plates, price 7*s.* 6*d.* cloth.

"The arrangement of the matter in this little volume is as convenient as it well could be. . . . . The system of employing diagrams as a substitute for complex computations is one justly coming into great favour, and in that respect Mr. Humber's volume is fully up to the times."—*Engineering.*

"The formulæ are neatly expressed, and the diagrams good."—*Athenæum.*

"Mr. Humber has rendered a great service to the architect and engineer by producing a work especially treating on the methods of delineating the strains on iron beams, roofs, and bridges by means of diagrams."—*Builder.*

Barlow on the Strength of Materials, enlarged.

A TREATISE ON THE STRENGTH OF MATERIALS, with Rules for application in Architecture, the Construction of Suspension Bridges, Railways, &c.; and an Appendix on the Power of Locomotive Engines, and the effect of Inclined Planes and Gradients. By PETER BARLOW, F.R.S. A New Edition, revised by his Sons, P. W. BARLOW, F.R.S., and W. H. BARLOW, F.R.S., to which are added Experiments by HODGKINSON, FAIRBAIRN, and KIRKALDY; an Essay (with Illustrations) on the effect produced by passing Weights over Elastic Bars, by the Rev. ROBERT WILLIS, M.A., F.R.S. And Formulæ for Calculating Girders, &c. The whole arranged and edited by W. HUMBER, Assoc. Inst. C.E., Author of "A Complete and Practical Treatise on Cast and Wrought-Iron Bridge Construction," &c. 8vo, 400 pp., with 19 large Plates, and numerous woodcuts, 18*s.* cloth.

"The book is undoubtedly worthy of the highest commendation."—*Mining Journal.*

"The best book on the subject which has yet appeared. . . . . We know of no work that so completely fulfils its mission."—*English Mechanic.*

"The standard treatise upon this particular subject."—*Engineer.*

Iron and Steel.

'IRON AND STEEL': a Work for the Forge, Foundry, Factory, and Office. Containing Ready, Useful, and Trustworthy Information for Ironmasters and their Stocktakers; Managers of Bar, Rail, Plate, and Sheet Rolling Mills; Iron and Metal Founders; Iron Ship and Bridge Builders; Mechanical, Mining, and Consulting Engineers; Architects, Contractors, Builders, and Professional Draughtsmen. By CHARLES HOARE, Author of 'The Slide Rule,' &c. Eighth Edition. Revised throughout and considerably enlarged. With folding Scales of "Foreign Measures compared with the English Foot," and "fixed Scales of Squares, Cubes, and Roots, Areas, Decimal Equivalents, &c." Oblong, 32mo, leather elastic-band, 6*s*.

"We cordially recommend this book to those engaged in considering the details of all kinds of iron and steel works. . . . . It has been compiled with care and accuracy. . . . . Many useful rules and hints are given for lessening the amount of arithmetical labour which is always more or less necessary in arranging iron and steel work of all kinds, and a great quantity of useful tables for preparing estimates of weights, dimensions, strengths of structures, costs of work, &c., will be found in Mr. Hoare's book.—*Naval Science.*

Weale's Engineers' Pocket-Book.

THE ENGINEERS', ARCHITECTS', and CONTRACTORS' POCKET-BOOK (LOCKWOOD & Co.'s; formerly WEALE'S). Published Annually. In roan tuck, gilt edges, with 10 Copper-Plates and numerous Woodcuts. Price 6*s*.

"A vast amount of really valuable matter condensed into the small dimensions of a book which is, in reality, what it professes to be—a pocket-book. . . . . We cordially recommend the book.—*Colliery Guardian.*

"It contains a large amount of information peculiarly valuable to those for whose use it is compiled. We cordially commend it to the engineering and architectural professions generally."—*Mining Journal.*

Iron Bridges, Girders, Roofs, &c.

A TREATISE on the APPLICATION of IRON to the CONSTRUCTION of BRIDGES, GIRDERS, ROOFS, and OTHER WORKS; showing the Principles upon which such Structures are Designed, and their Practical Application. Especially arranged for the use of Students and Practical Mechanics, all Mathematical Formulæ and Symbols being excluded. By FRANCIS CAMPIN, C.E. Second Edition revised and corrected. With numerous Diagrams. 12mo, cloth boards, 3*s*.

"Invaluable to those who have not been educated in mathematics."—*Colliery Guardian.*

"Remarkably accurate and well written."—*Artisan.*

Mechanical Engineering.

A PRACTICAL TREATISE ON MECHANICAL ENGINEERING: comprising Metallurgy, Moulding, Casting, Forging, Tools, Workshop Machinery, Mechanical Manipulation, Manufacture of the Steam Engine, &c. &c. With an Appendix on the Analysis of Iron and Iron Ore, and Glossary of Terms. By FRANCIS CAMPIN, C.E. Illustrated with 91 Woodcuts and 28 Plates of Slotting, Shaping, Drilling, Punching, Shearing, and Riveting Machines—Blast, Refining, and Reverberatory Furnaces—Steam Engines, Governors, Boilers, Locomotives, &c. 8vo. cloth, 12*s*.

Pioneer Engineering.

PIONEER ENGINEERING. A Treatise on the Engineering Operations connected with the Settlement of Waste Lands in New Countries. By EDWARD DOBSON, Assoc. Inst. C.E., Author of "The Art of Building," &c. With numerous Plates and Wood Engravings. Crown 8vo, 10*s.* 6*d.* [*Just published.*

"A most useful handbook to engineering pioneers."—*Iron*, Dec. 2, 1876.

"The author's experience has been turned to good account, and the book is likely to be of considerable service to pioneer engineers."—*Building News.*

"Promises a great deal, and fulfils most of its promises. . . . . Of use to the colonial pioneering surveyor and engineer."—*Scotsman.*

New Iron Trades' Companion.

THE IRON AND METAL TRADES' COMPANION: Being a Calculator containing a Series of Tables upon a new and comprehensive plan for expeditiously ascertaining the value of any goods bought or sold by weight, from 1*s.* per cwt. to 112*s.* per cwt., and from one farthing per pound to one shilling per pound. Each Table extends from one pound to 100 tons; to which are appended Rules on Decimals, Square and Cube Root, Mensuration of Superficies and Solids, &c.; also Tables of Weights of Materials, and other Useful Memoranda. By THOMAS DOWNIE. Strongly bound in leather, 396 pp., price 9*s.*

"A most useful set of tables, and will supply a want, for nothing like them before existed."—*Building News*, Dec. 8, 1876.

"We have tested the calculations at random and found them correct."—*Colliery Guardian*, Dec. 1, 1876.

"Will save the possessor the trouble of making numerous intricate calculations. Although specially adapted to the iron and metal trades, the tables contained in this handy little companion will be found useful in every other business in which merchandise is bought and sold by weight."—*Railway News*, Dec. 9, 1876.

Sanitary Work.

SANITARY WORK IN THE SMALLER TOWNS AND IN VILLAGES. Comprising:—1. Some of the more Common Forms of Nuisance and their Remedies; 2. Drainage; 3. Water Supply. A useful book for Members of Local Boards and Rural Sanitary Authorities, Health Officers, Engineers, Surveyors, Builders, and Contractors. By CHARLES SLAGG, Assoc. Inst. C.E. Crown 8vo. cloth, price 5*s.* [*Just published.*

"Mr. Slagg has brought together much valuable information, and has a happy lucidity of expression; and he has been industrious in collecting data."—*Athenæum.*

"This is a very useful book, and may be safely recommended. . . . . The author, Mr. Charles Slagg, has had practical experience in the works of which he treats. There is a great deal of work required to be done in the smaller towns and villages, and this little volume will help those who are willing to do it."—*Builder.*

Steam Engine.

STEAM AND THE STEAM ENGINE, Stationary and Portable, an Elementary Treatise on. Being an Extension of Mr. John Sewell's Treatise on Steam. By D. KINNEAR CLARK, C.E., M.I.C.E., Author of "Railway Locomotives," &c. With Illustrations. 12mo, cloth, 4*s.*

"Every essential part of the subject is treated of competently, and in a popular style."—*Iron.*

Strains.

THE STRAINS ON STRUCTURES OF IRONWORK; with Practical Remarks on Iron Construction. By F. W. SHEILDS, M. Inst. C.E. Second Edition, with 5 plates. Royal 8vo, 5*s.* cloth.

CONTENTS.—Introductory Remarks; Beams Loaded at Centre; Beams Loaded at unequal distances between supports; Beams uniformly Loaded; Girders with triangular bracing Loaded at centre; Ditto, Loaded at unequal distances between supports; Ditto, uniformly Loaded; Calculation of the Strains on Girders with triangular Basings; Cantilevers; Continuous Girders; Lattice Girders; Girders with Vertical Struts and Diagonal Ties; Calculation of the Strains on Ditto; Bow and String Girders; Girders of a form not belonging to any regular figure; Plate Girders; Apportionments of Material to Strain; Comparison of different Girders; Proportion of Length to Depth of Girders; Character of the Work; Iron Roofs.

Construction of Iron Beams, Pillars, &c.

IRON AND HEAT, Exhibiting the Principles concerned in the Construction of Iron Beams, Pillars, and Bridge Girders, and the Action of Heat in the Smelting Furnace. By JAMES ARMOUR, C.E. Woodcuts, 12mo, cloth boards, 3*s.* 6*d.*; cloth limp, 2*s.* 6*d.*

"A very useful and thoroughly practical little volume, in every way deserving of circulation amongst working men."—*Mining Journal.*

"No ironworker who wishes to acquaint himself with the principles of his own trade can afford to be without it."—*South Durham Mercury.*

Power in Motion.

POWER IN MOTION: Horse Power, Motion, Toothed Wheel Gearing, Long and Short Driving Bands, Angular Forces, &c. By JAMES ARMOUR, C.E. With 73 Diagrams. 12mo, cloth boards, 3*s.* 6*d.*

"Numerous illustrations enable the author to convey his meaning as explicitly as it is perhaps possible to be conveyed. The value of the theoretic and practical knowledge imparted cannot well be over estimated."—*Newcastle Weekly Chronicle.*

Metallurgy of Iron.

A TREATISE ON THE METALLURGY OF IRON: containing Outlines of the History of Iron Manufacture, Methods of Assay, and Analyses of Iron Ores, Processes of Manufacture of Iron and Steel, &c. By H. BAUERMAN, F.G.S., Associate of the Royal School of Mines. With numerous Illustrations. Fourth Edition, revised and much enlarged. 12mo, cloth boards, 5*s.* 6*d.*

"Carefully written, it has the merit of brevity and conciseness, as to less important points, while all material matters are very fully and thoroughly entered into."—*Standard.*

Trigonometrical Surveying.

AN OUTLINE OF THE METHOD OF CONDUCTING A TRIGONOMETRICAL SURVEY, for the Formation of Geographical and Topographical Maps and Plans, Military Reconnaissance, Levelling, &c., with the most useful Problems in Geodesy and Practical Astronomy, and Formulæ and Tables for Facilitating their Calculation. By LIEUT-GENERAL FROME, R.E., late Inspector-General of Fortifications, &c. Fourth Edition, Enlarged, thoroughly Revised, and partly Re-written. By CAPTAIN CHARLES WARREN, R.E., F.G.S. With 19 Plates and 115 Woodcuts, royal 8vo, price 16*s.* cloth.

Practical Tunnelling.

PRACTICAL TUNNELLING: Explaining in detail the Setting out of the Works, Shaft-sinking and Heading-Driving, Ranging the Lines and Levelling under Ground, Sub-Excavating, Timbering, and the Construction of the Brickwork of Tunnels with the amount of labour required for, and the Cost of, the various portions of the work. By FREDERICK WALTER SIMMS, M. Inst. C.E., author of "A Treatise on Levelling." Third Edition, Revised and Extended, with additional chapters illustrating the Recent Practice of Tunnelling as exemplified by the St. Gothard, Mont Cenis, and other modern works, by D. KINNEAR CLARK, M. Inst. C.E. Imp. 8vo, cloth, with 21 Folding Plates and numerous Wood Engravings, price 30*s.* [*Just published.*

"It is the only practical treatise on the great art of tunnelling. Mr. Clark's work brings the exigencies of tunnel enterprise up to our own time. The great length of modern tunnels has led to a new difficulty in the art, which the last generation was ignorant of, namely, the difficulty of ventilation. In Mr. Clark's supplement we find this branch of the subject has been fully considered. Mr. Clark's additional chapters on the Mont Cenis and St. Gothard Tunnels contain minute and valuable experiences and data relating to the method of excavation by compressed air, the heading operations, rock-boring machinery, process of enlargement, ventilation in course of construction by compressed air, labour and cost, &c."—*Building News*, Dec. 8, 1876.

"The estimation in which Mr. Simms' book on tunnelling has been held for over thirty years cannot be more truly expressed than in the words of the late Professor Rankine:—'The best source of information on the subject of tunnels is Mr. F. W. Simms' work on "Practical Tunnelling."'—*The Architect*, Dec. 9, 1876.

Levelling.

A TREATISE on the PRINCIPLES and PRACTICE of LEVELLING; showing its Application to Purposes of Railway and Civil Engineering, in the Construction of Roads; with Mr. TELFORD'S Rules for the same. By FREDERICK W. SIMMS, F.G.S., M. Inst. C.E. Sixth Edition, very carefully revised, with the addition of Mr. LAW'S Practical Examples for Setting out Railway Curves, and Mr. TRAUTWINE'S Field Practice of Laying out Circular Curves. With 7 Plates and numerous Woodcuts. 8vo, 8*s.* 6*d.* cloth. **** TRAUTWINE on Curves, separate, price 5*s.*

"One of the most important text-books for the general surveyor, and there is scarcely a question connected with levelling for which a solution would be sought but that would be satisfactorily answered by consulting the volume."—*Mining Journal.*

"The text-book on levelling in most of our engineering schools and colleges."—*Engineer.*

The High-Pressure Steam Engine.

THE HIGH-PRESSURE STEAM ENGINE; an Exposition of its Comparative Merits, and an Essay towards an Improved System of Construction, adapted especially to secure Safety and Economy. By Dr. ERNST ALBAN, Practical Machine Maker, Plau, Mecklenberg. Translated from the German, with Notes, by Dr. POLE, F.R.S., M. Inst. C.E., &c. &c. With 28 fine Plates, 8vo, 16*s.* 6*d.* cloth.

"A work like this, which goes thoroughly into the examination of the high-pressure engine, the boiler, and its appendages, &c., is exceedingly useful, and deserves a place in every scientific library."—*Steam Shipping Chronicle.*

Hydraulics.

HYDRAULIC TABLES, CO-EFFICIENTS, and FORMULÆ for finding the Discharge of Water from Orifices, Notches, Weirs, Pipes, and Rivers. With New Formulæ, Tables, and General Information on Rain-fall, Catchment-Basins, Drainage, Sewerage, Water Supply for Towns and Mill Power. By JOHN NEVILLE, Civil Engineer, M.R.I.A. Third Edition, carefully revised, with considerable Additions. Numerous Illustrations. Cr. 8vo, 14*s.* cloth.

"Undoubtedly an exceedingly useful and elaborate compilation."—*Iron.*

"Will prove alike valuable to students and engineers in practice; its study will prevent the annoyance of avoidable failures, and assist them to select the readiest means of successfully carrying out any given work connected with hydraulic engineering."—*Mining Journal.*

Strength of Cast Iron, &c.

A PRACTICAL ESSAY on the STRENGTH of CAST IRON and OTHER METALS. By the late THOMAS TREDGOLD, Mem. Inst. C.E., Author of "Elementary Principles of Carpentry," &c. Fifth Edition, Edited by EATON HODGKINSON, F.R.S.; to which are added EXPERIMENTAL RESEARCHES on the STRENGTH and OTHER PROPERTIES of CAST IRON. By the EDITOR. The whole Illustrated with 9 Engravings and numerous Woodcuts. 8vo, 12*s.* cloth.

*** HODGKINSON'S EXPERIMENTAL RESEARCHES ON THE STRENGTH AND OTHER PROPERTIES OF CAST IRON may be had separately. With Engravings and Woodcuts. 8vo, price 6*s.* cloth.

Steam Boilers.

A TREATISE ON STEAM BOILERS: their Strength, Construction, and Economical Working. By ROBERT WILSON, late Inspector for the Manchester Steam Users' Association for the Prevention of Steam Boiler Explosions, and for the Attainment of Economy in the Application of Steam. Fourth Edition. 12mo, cloth boards, 328 pages, price 6*s.*

"We regard Mr. Wilson's treatise as the best work on boilers which has come under our notice, and we consider that all boiler makers and boiler owners should give it a place in their libraries."—*Engineering.*

"The best treatise that has ever been published on steam boilers."—*Engineer.*

"A valuable contribution to the subject of steam boiler literature. . . . . The book is full of hints which the proprietor of a steam boiler would find it to his advantage to know."—*Iron and Coal Trades Review.*

Tables of Curves.

TABLES OF TANGENTIAL ANGLES and MULTIPLES for setting out Curves from 5 to 200 Radius. By ALEXANDER BEAZELEY, M. Inst. C.E. Printed on 48 Cards, and sold in a cloth box, waistcoat-pocket size, price 3*s.* 6*d.*

"Each table is printed on a small card, which, being placed on the theodolite, leaves the hands free to manipulate the instrument—no small advantage as regards the rapidity of work. They are clearly printed, and compactly fitted into a small case for the pocket—an arrangement that will recommend them to all practical men."—*Engineer.*

"Very handy: a man may know that all his day's work must fall on two of these cards, which he puts into his own card-case, and leaves the rest behind."—*Athenæum.*

Earthwork.

EARTHWORK TABLES, showing the Contents in Cubic Yards of Embankments, Cuttings, &c., of Heights or Depths up to an average of 80 feet. By JOSEPH BROADBENT, C.E., and FRANCIS CAMPIN, C.E. Cr. 8vo, oblong, 5*s.* cloth.

"Creditable to both the authors and the publishers. . . . The way in which accuracy is attained, by a simple division of each cross section into three elements, two of which are constant and one variable, is ingenious."—*Athenæum.*

"Likely to be of considerable service to engineers."—*Building News.*

"Cannot fail to come into general use."—*Mining Journal.*

"These tables, which are clearly printed and easily arranged for reference, will be found to facilitate the accurate determination of the quantities of earthwork in making out estimates."—*English Mechanic.*

Surveying (Land and Marine).

LAND AND MARINE SURVEYING, in Reference to the Preparation of Plans for Roads and Railways, Canals, Rivers, Towns' Water Supplies, Docks and Harbours; with Description and Use of Surveying Instruments. By W. DAVIS HASKOLL, C.E., Author of "The Engineer's Field Book," "Examples of Bridge and Viaduct Construction," &c. Demy 8vo, price 12*s.* 6*d.* cloth, with 14 folding Plates, and numerous Woodcuts.

"A most useful and well arranged book for the aid of a student. . . . . We can strongly recommend it as a carefully-written and valuable text-book."—*Builder.*

"Mr. Haskoll has knowledge and experience, and can so give expression to it as to make any matter on which he writes, clear to the youngest pupil in a surveyor's office."—*Colliery Guardian.*

"A volume which cannot fail to prove of the utmost practical utility. . . . . It is one which may be safely recommended to all students who aspire to become clean and expert surveyors."—*Mining Journal.*

Engineering Fieldwork.

THE PRACTICE OF ENGINEERING FIELDWORK, applied to Land and Hydraulic, Hydrographic, and Submarine Surveying and Levelling. Second Edition, revised, with considerable additions, and a Supplementary Volume on WATER-WORKS, SEWERS, SEWAGE, and IRRIGATION. By W. DAVIS HASKOLL, C.E. Numerous folding Plates. Demy 8vo, 2 vols. in one, cloth boards, 1*l.* 1*s.* (published at 2*l.* 4*s.*)

Mining, Surveying and Valuing.

THE MINERAL SURVEYOR AND VALUER'S COMPLETE GUIDE, comprising a Treatise on Improved Mining Surveying, with new Traverse Tables; and Descriptions of Improved Instruments; also an Exposition of the Correct Principles of Laying out and Valuing Home and Foreign Iron and Coal Mineral Properties: to which is appended M. THOMAN'S (of the Crédit Mobilier, Paris) TREATISE on COMPOUND INTEREST and ANNUITIES, with LOGARITHMIC TABLES. By WILLIAM LINTERN, Mining and Civil Engineer. 12mo, strongly bound in cloth boards, with four Plates of Diagrams, Plans, &c., price 10*s.* 6*d.*

"Contains much valuable information given in a small compass, and which, as far as we have tested it, is thoroughly trustworthy."—*Iron and Coal Trades Review.*

"The matter, arrangement, and illustration of this work are all excellent, and make it one of the best of its kind."—*Standard.*

Fire Engineering.

FIRES, FIRE-ENGINES, AND FIRE BRIGADES. With a History of Fire-Engines, their Construction, Use, and Management; Remarks on Fire-Proof Buildings, and the Preservation of Life from Fire; Statistics of the Fire Appliances in English Towns; Foreign Fire Systems; Hints on Fire Brigades, &c., &c. By CHARLES F. T. YOUNG, C.E. With numerous Illustrations, handsomely printed, 544 pp., demy 8vo, price *1l.* 4*s.* cloth.

"We can most heartily commend this book. . . . . It is really the only English work we now have upon the subject."—*Engineering.*

"We strongly recommend the book to the notice of all who are in any way interested in fires, fire-engines, or fire-brigades."—*Mechanics' Magazine.*

Manual of Mining Tools.

MINING TOOLS. For the use of Mine Managers, Agents, Mining Students, &c. By WILLIAM MORGANS, Lecturer on Practical Mining at the Bristol School of Mines. Volume of Text. 12mo. With an Atlas of Plates, containing 235 Illustrations. 4to. Together, price 9*s.* cloth boards.

"Students in the Science of Mining, and not only they, but subordinate officials in mines, and even Overmen, Captains, Managers, and Viewers may gain practical knowledge and useful hints by the study of Mr. Morgans' Manual."—*Colliery Guardian.*

"A very valuable work, which will tend materially to improve our mining literature."—*Mining Journal.*

Common Sense for Gas-Users.

COMMON SENSE FOR GAS-USERS: a Catechism of Gas-Lighting for Householders, Gasfitters, Millowners, Architects, Engineers, &c., &c. By ROBERT WILSON, C.E., Author of "A Treatise on Steam Boilers." Crown 8vo. sewed, with Folding Plates and Wood Engravings, 2*s.* 6*d.* [*Just published.*

Gas and Gasworks.

A TREATISE on GASWORKS and the PRACTICE of MANUFACTURING and DISTRIBUTING COAL GAS. By SAMUEL HUGHES, C.E. Fourth Edition, revised by W. RICHARDS, C.E. With 68 Woodcuts, 12mo, cloth boards, 4*s.*

Waterworks for Cities and Towns.

WATERWORKS for the SUPPLY of CITIES and TOWNS, with a Description of the Principal Geological Formations of England as influencing Supplies of Water. By SAMUEL HUGHES, F.G.S., Civil Engineer. New and enlarged edition, 12mo, cloth boards, with numerous Illustrations, price 5*s.*

"One of the most convenient, and at the same time reliable works on a subject, the vital importance of which cannot be over-estimated."—*Bradford Observer.*

Coal and Coal Mining.

COAL AND COAL MINING: a Rudimentary Treatise on. By WARINGTON W. SMYTH, M.A., F.R.S., &c., Chief Inspector of the Mines of the Crown and of the Duchy of Cornwall. New edition, revised and corrected. 12mo, cloth boards, with numerous Illustrations, price 4*s.* 6*d.*

"Every portion of the volume appears to have been prepared with much care, and as an outline is given of every known coal-field in this and other countries, as well as of the two principal methods of working, the book will doubtless interest a very large number of readers."—*Mining Journal.*

Field-Book for Engineers.

THE ENGINEER'S, MINING SURVEYOR'S, and CONTRACTOR'S FIELD-BOOK. By W. DAVIS HASKOLL, Civil Engineer. Third Edition, much enlarged, consisting of a Series of Tables, with Rules, Explanations of Systems, and Use of Theodolite for Traverse Surveying and Plotting the Work with minute accuracy by means of Straight Edge and Set Square only; Levelling with the Theodolite, Casting out and Reducing Levels to Datum, and Plotting Sections in the ordinary manner; Setting out Curves with the Theodolite by Tangential Angles and Multiples with Right and Left-hand Readings of the Instrument; Setting out Curves without Theodolite on the System of Tangential Angles by Sets of Tangents and Offsets; and Earthwork Tables to 80 feet deep, calculated for every 6 inches in depth. With numerous wood-cuts, 12mo, price 12*s.* cloth.

"A very useful work for the practical engineer and surveyor. Every person engaged in engineering field operations will estimate the importance of such a work and the amount of valuable time which will be saved by reference to a set of reliable tables prepared with the accuracy and fulness of those given in this volume."—*Railway News.*

"The book is very handy, and the author might have added that the separate tables of sines and tangents to every minute will make it useful for many other purposes, the genuine traverse tables existing all the same."—*Athenæum.*

"The work forms a handsome pocket volume, and cannot fail, from its portability and utility, to be extensively patronised by the engineering profession."—*Mining Journal.*

"We strongly recommend Mr. Haskoll's 'Field Book' to all classes of surveyors."—*Colliery Guardian.*

"We know of no better field-book of reference or collection of tables than Mr. Haskoll's."—*Artizan.*

Earthwork, Measurement and Calculation of.

A MANUAL on EARTHWORK. By ALEX. J. S. GRAHAM, C.E., Resident Engineer, Forest of Dean Central Railway. With numerous Diagrams. 18mo, 2*s.* 6*d.* cloth.

"As a really handy book for reference, we know of no work equal to it; and the railway engineers and others employed in the measurement and calculation of earth work will find a great amount of practical information very admirably arranged, and available for general or rough estimates, as well as for the more exact calculations required in the engineers' contractor's offices."—*Artizan.*

Harbours.

THE DESIGN and CONSTRUCTION of HARBOURS: A Treatise on Maritime Engineering. By THOMAS STEVENSON, F.R.S.E., F.G.S., M.I.C.E. Second Edition, containing many additional subjects, and otherwise generally extended and revised. With 20 Plates and numerous Cuts. Small 4to, 15*s.* cloth.

Mathematical and Drawing Instruments.

A TREATISE ON THE PRINCIPAL MATHEMATICAL AND DRAWING INSTRUMENTS employed by the Engineer, Architect, and Surveyor. By FREDERICK W. SIMMS, M. Inst. C.E., Author of "Practical Tunnelling," &c. Third Edition, with numerous Cuts. 12mo, price 3*s.* 6*d.* cloth.

Bridge Construction in Masonry, Timber, & Iron.

EXAMPLES OF BRIDGE AND VIADUCT CONSTRUCTION OF MASONRY, TIMBER, AND IRON; consisting of 46 Plates from the Contract Drawings or Admeasurement of select Works. By W. DAVIS HASKOLL, C.E. Second Edition, with the addition of 554 Estimates, and the Practice of Setting out Works, illustrated with 6 pages of Diagrams. Imp. 4to, price *2l. 12s. 6d.* half-morocco.

"One of the very few works extant descending to the level of ordinary routine, and treating on the common every-day practice of the railway engineer. . . . A work of the present nature by a man of Mr. Haskoll's experience, must prove invaluable to hundreds. The tables of estimates appended to this edition will considerably enhance its value."—*Engineering.*

Mathematical Instruments, their Construction, &c.

MATHEMATICAL INSTRUMENTS: THEIR CONSTRUCTION, ADJUSTMENT, TESTING, AND USE; comprising Drawing, Measuring, Optical, Surveying, and Astronomical Instruments. By J. F. HEATHER, M.A., Author of "Practical Plane Geometry," "Descriptive Geometry," &c. Enlarged Edition, for the most part entirely rewritten. With numerous Wood-cuts. 12mo, cloth boards, price *5s.*

Drawing for Engineers, &c.

THE WORKMAN'S MANUAL OF ENGINEERING DRAWING. By JOHN MAXTON, Instructor in Engineering Drawing, Royal Naval College, Greenwich, formerly of R. S. N. A., South Kensington. Third Edition, carefully revised. With upwards of 300 Plates and Diagrams. 12mo, cloth, strongly bound, *4s. 6d.*

"Even accomplished draughtsmen will find in it much that will be of use to them. A copy of it should be kept for reference in every drawing office."—*Engineering.*

"Indispensable for teachers of engineering drawing."—*Mechanics' Magazine.*

Oblique Arches.

A PRACTICAL TREATISE ON THE CONSTRUCTION of OBLIQUE ARCHES. By JOHN HART. Third Edition, with Plates. Imperial 8vo, price *8s.* cloth.

Oblique Bridges.

A PRACTICAL and THEORETICAL ESSAY on OBLIQUE BRIDGES, with 13 large folding Plates. By GEO. WATSON BUCK, M. Inst. C.E. Second Edition, corrected by W. H. BARLOW, M. Inst. C.E. Imperial 8vo, *12s.* cloth.

"The standard text-book for all engineers regarding skew arches, is Mr. Buck's treatise, and it would be impossible to consult a better."—*Engineer.*

Pocket-Book for Marine Engineers.

A POCKET BOOK FOR MARINE ENGINEERS. Containing useful Rules and Formulæ in a compact form. By FRANK PROCTOR, A.I.N.A. Second Edition, revised and enlarged. Royal 32mo, leather, gilt edges, with strap, price *4s.*

"We recommend it to our readers as going far to supply a long-felt want."—*Naval Science.*

"A most useful companion to all marine engineers."—*United Service Gazette.*

"Scarcely anything required by a naval engineer appears to have been forgotten.—*Iron.*

Grantham's Iron Ship-Building, enlarged.

ON IRON SHIP-BUILDING; with Practical Examples and Details. Fifth Edition. Imp. 4to, boards, enlarged from 24 to 40 Plates (21 quite new), including the latest Examples. Together with separate Text, 12mo, cloth limp, also considerably enlarged. By JOHN GRANTHAM, M. Inst. C.E., &c. Price 2*l.* 2*s.* complete.

"A thoroughly practical work, and every question of the many in relation to iron shipping which admit of diversity of opinion, or have various and conflicting personal interests attached to them, is treated with sober and impartial wisdom and good sense. . . . . As good a volume for the instruction of the pupil or student of iron naval architecture as can be found in any language."—*Practical Mechanics' Journal.*

"A very elaborate work. . . . . It forms a most valuable addition to the history of iron shipbuilding, while its having been prepared by one who has made the subject his study for many years, and whose qualifications have been repeatedly recognised, will recommend it as one of practical utility to all interested in shipbuilding."—*Army and Navy Gazette.*

"Mr. Grantham's work is of great interest. . . . It is also valuable as a record of the progress of iron shipbuilding. . . . It will, we are confident, command an extensive circulation among shipbuilders in general. . . . By order of the Board of Admiralty, the work will form the text-book on which the examination in iron shipbuilding of candidates for promotion in the dockyards will be mainly based."—*Engineering.*

Weale's Dictionary of Terms.

A DICTIONARY of TERMS used in ARCHITECTURE, BUILDING, ENGINEERING, MINING, METALLURGY, ARCHÆOLOGY, the FINE ARTS, &c. By JOHN WEALE. Fifth Edition, revised and corrected by ROBERT HUNT, F.R.S., Keeper of Mining Records, Editor of "Ure's Dictionary of Arts" &c. 12mo, cloth boards, price 6*s.*

"A book for the enlightenment of those whose memory is treacherous or education deficient in matters scientific and industrial. The additions made of modern discoveries and knowledge are extensive. The result is 570 pages of concentrated essence of elementary knowledge, admirably and systematically arranged, and presented in neat and handy form."—*Iron.*

"The best small technological dictionary in the language."—*Architect.*

"A comprehensive and accurate compendium. Author, editor, and publishers deserve high commendations for producing such a useful work. We can warmly recommend such a dictionary as a standard work of reference to our subscribers. Every ironmonger should procure it—no engineer should be without it—builders and architects must admire it—metallurgists and archæologists would profit by it."—*Ironmonger.*

"The absolute accuracy of a work of this character can only be judged of after extensive consultation, and from our examination it appears very correct and very complete."—*Mining Journal.*

"There is no need now to speak of the excellence of this work; it received the approval of the community long ago. Edited now by Mr. Robert Hunt, and published in a cheap, handy form, it will be of the utmost service as a book of reference scarcely to be exceeded in value."—*Scotsman.*

Steam.

THE SAFE USE OF STEAM: containing Rules for Unprofessional Steam Users. By an ENGINEER. Third Edition. 12mo. Sewed, 6*d.*

N. B.—*This little work should be in the hands of every person having to deal with a Steam Engine of any kind.*

"If steam-users would but learn this little book by heart, and then hand it to their stokers to do the same, and see that the latter do it, boiler explosions would become sensations by their rarity."—*English Mechanic.*

ARCHITECTURE, &c.

Construction.

THE SCIENCE of BUILDING: An Elementary Treatise on the Principles of Construction. By E. WYNDHAM TARN, M.A., Architect. With 47 Wood Engravings. Demy 8vo. 8*s.* 6*d.* cloth.

"A very valuable book, which we strongly recommend to all students."—*Builder.*

"No architectural student should be without this hand-book."—*Architect.*

"An able digest of information which is only to be found scattered through various works."—*Engineering.*

Beaton's Pocket Estimator.

THE POCKET ESTIMATOR FOR THE BUILDING TRADES, being an easy method of estimating the various parts of a Building collectively, more especially applied to Carpenters' and Joiners' work, priced according to the present value of material and labour. By A. C. BEATON, Author of 'Quantities and Measurements.' 33 Woodcuts. Leather. Waistcoat-pocket size. 2*s.*

Beaton's Builders' and Surveyors' Technical Guide.

THE POCKET TECHNICAL GUIDE AND MEASURER FOR BUILDERS AND SURVEYORS: containing a Complete Explanation of the Terms used in Building Construction, Memoranda for Reference, Technical Directions for Measuring Work in all the Building Trades, &c., &c. By A. C. BEATON, Author of 'Quantities and Measurements.' With 19 Woodcuts. Leather. Waistcoat-pocket size. 2*s.*

Villa Architecture.

A HANDY BOOK of VILLA ARCHITECTURE; being a Series of Designs for Villa Residences in various Styles. With Detailed Specifications and Estimates. By C. WICKES, Architect, Author of "The Spires and Towers of the Mediæval Churches of England," &c. First Series, consisting of 30 Plates; Second Series, 31 Plates. Complete in 1 vol. 4to, price 2*l.* 10*s.* half morocco. Either Series separate, price 1*l.* 7*s.* each, half morocco.

"The whole of the designs bear evidence of their being the work of an artistic architect, and they will prove very valuable and suggestive to architects, students, and amateurs."—*Building News.*

House Painting.

HOUSE PAINTING, GRAINING, MARBLING, AND SIGN WRITING: a Practical Manual of. With 9 Coloured Plates of Woods and Marbles, and nearly 150 Wood Engravings. By ELLIS A. DAVIDSON, Author of 'Building Construction,' &c. Second Edition, carefully revised. 12mo, 6*s.* cloth boards.

"Many persons in the trade may profit by a study of the chapters on the 'Principles of Decorative Art,' and of what we may call the 'lessons' on drawing suitable for sign painters, writers, and decorators. These chapters will be of considerable value to the painter's apprentices, while his journeymen will certainly be interested if not benefited by their perusal. The book is freely illustrated, and has some coloured plates of woods and marbles. It contains a mass of information of use to the amateur and of value to the practical man."—*English Mechanic.*

"Deals with the practice of painting in all its parts, from the grinding of colours to varnishing and gilding."—*Architect.*

"Carefully and lucidly written, and entirely reliable."—*Builders' Weekly Reporter.*

A Book on Building.

A BOOK ON BUILDING, CIVIL AND ECCLESIASTICAL. By Sir EDMUND BECKETT, Bart., LL.D., Q.C., F.R.A.S., Author of "Clocks and Watches and Bells," &c. Crown 8vo, cloth, with Illustrations, price 7*s.* 6*d.*

"A book which is always amusing and nearly always instructive. Sir E. Beckett will be read for the raciness of his style. We are able very cordially to recommend all persons to read it for themselves. The style throughout is in the highest degree condensed and epigrammatic."—*Times*, Dec. 8, 1876.

"We commend the book to the thoughtful consideration of all who are interested in the building art."—*Builder*, Dec. 2, 1876.

"There is hardly a subject connected with either building or repairing on which sensible and practical directions will not be found, the use of which is probably destined to prevent many an annoyance, disappointment, and unnecessary expense."—*Daily News*, Nov. 28, 1876.

Architecture, Ancient and Modern.

RUDIMENTARY ARCHITECTURE, Ancient and Modern. Consisting of VITRUVIUS, translated by JOSEPH GWILT, F.S.A., &c., with 23 fine copper plates; GRECIAN Architecture, by the EARL of ABERDEEN; the ORDERS of Architecture, by W. H. LEEDS, Esq.; The STYLES of Architecture of Various Countries, by T. TALBOT BURY; The PRINCIPLES of DESIGN in Architecture, by E. L. GARBETT. In one volume, half-bound (pp. 1,100), copiously illustrated, 12*s.*

*** *Sold separately, in two vols., as follows—*

ANCIENT ARCHITECTURE. Containing Gwilt's Vitruvius and Aberdeen's Grecian Architecture. Price 6*s.* half-bound.

N.B.—*This is the only edition of VITRUVIUS procurable at a moderate price.*

MODERN ARCHITECTURE. Containing the Orders, by Leeds; The Styles, by Bury; and Design, by Garbett. 6*s.* half-bound.

The Young Architect's Book.

HINTS TO YOUNG ARCHITECTS. By GEORGE WIGHTWICK, Architect, Author of "The Palace of Architecture," &c. &c. New Edition, revised and enlarged. By G. HUSKISSON GUILLAUME, Architect. Numerous illustrations. 12mo, cloth boards, 4*s.*

"Will be found an acquisition to pupils, and a copy ought to be considered as necessary a purchase as a box of instruments."—*Architect.*

"Contains a large amount of information, which young architects will do well to acquire, if they wish to succeed in the everyday work of their profession.—*English Mechanic.*

Drawing for Builders and Students.

PRACTICAL RULES ON DRAWING for the OPERATIVE BUILDER and YOUNG STUDENT in ARCHITECTURE. By GEORGE PYNE, Author of a "Rudimentary Treatise on Perspective for Beginners." With 14 Plates, 4to, 7*s.* 6*d.* boards.

Builder's and Contractor's Price Book.

LOCKWOOD & CO.'S BUILDER'S AND CONTRACTOR'S PRICE BOOK for 1877, containing the latest prices of all kinds of Builders' Materials and Labour, and of all Trades connected with Building, &c., &c. The whole revised and edited by FRANCIS T. W. MILLER, Architect and Surveyor. Fcap. 8vo, strongly half-bound, price 4*s.*

Handbook of Specifications.

THE HANDBOOK OF SPECIFICATIONS; or, Practical Guide to the Architect, Engineer, Surveyor, and Builder, in drawing up Specifications and Contracts for Works and Constructions. Illustrated by Precedents of Buildings actually executed by eminent Architects and Engineers. Preceded by a Preliminary Essay, and Skeletons of Specifications and Contracts, &c., &c. By Professor THOMAS L. DONALDSON, M.I.B.A. With A REVIEW OF THE LAW OF CONTRACTS. By W. CUNNINGHAM GLEN, of the Middle Temple. With 33 Lithographic Plates, 2 vols., 8vo, *2l. 2s.*

"In these two volumes of 1,100 pages (together), forty-four specifications of executed works are given, including the specifications for parts of the new Houses of Parliament, by Sir Charles Barry, and for the new Royal Exchange, by Mr. Tite, M.P. Donaldson's Handbook of Specifications must be bought by all architects."—*Builder.*

Taylor and Cresy's Rome.

THE ARCHITECTURAL ANTIQUITIES OF ROME. By the late G. L. TAYLOR, Esq., F.S.A., and EDWARD CRESY, Esq. New Edition, thoroughly revised, and supplemented under the editorial care of the Rev. ALEXANDER TAYLOR, M.A. (son of the late G. L. Taylor, Esq.), Chaplain of Gray's Inn. This is the only book which gives on a large scale, and with the precision of architectural measurement, the principal Monuments of Ancient Rome in plan, elevation, and detail. Large folio, with 130 Plates, half-bound, price *3l. 3s.*

*** Originally published in two volumes, folio, at *18l. 18s.*

Specifications for Practical Architecture.

SPECIFICATIONS FOR PRACTICAL ARCHITECTURE: A Guide to the Architect, Engineer, Surveyor, and Builder; with an Essay on the Structure and Science of Modern Buildings. By FREDERICK ROGERS, Architect. With numerous Illustrations. Demy 8vo, price *15s.*, cloth. (Published at *1l. 10s.*)

*** A volume of specifications of a practical character being greatly required, and the old standard work of Alfred Bartholomew being out of print, the author, on the basis of that work, has produced the above. He has also inserted specifications of works that have been erected in his own practice.

The House-Owner's Estimator.

THE HOUSE-OWNER'S ESTIMATOR; or, What will it Cost to Build, Alter, or Repair? A Price-Book adapted to the Use of Unprofessional People as well as for the Architectural Surveyor and Builder. By the late JAMES D. SIMON, A.R.I.B.A. Edited and Revised by FRANCIS T. W. MILLER, Surveyor. With numerous Illustrations. Second Edition, with the prices carefully revised to 1875. Crown 8vo, cloth, price *3s. 6d.*

"In two years it will repay its cost a hundred times over."—*Field.*

"A very handy book for those who want to know what a house will cost to build, alter, or repair."—*English Mechanic.*

"Especially valuable to non-professional readers.—*Mining Journal.*

Useful Text-Book for Architects.

THE ARCHITECT'S GUIDE: Being a Text-book of Useful Information for Architects, Engineers, Surveyors, Contractors, Clerks of Works, &c., &c. By FREDERICK ROGERS, Architect, Author of 'Specifications for Practical Architecture,' &c. With numerous Illustrations. Crown 8vo, 6*s.* cloth. [Just Published.

CARPENTRY, TIMBER, MECHANICS.

Tredgold's Carpentry, new and cheaper Edition.

THE ELEMENTARY PRINCIPLES OF CARPENTRY: a Treatise on the Pressure and Equilibrium of Timber Framing, the Resistance of Timber, and the Construction of Floors, Arches, Bridges, Roofs, Uniting Iron and Stone with Timber, &c. To which is added an Essay on the Nature and Properties of Timber, &c., with Descriptions of the Kinds of Wood used in Building; also numerous Tables of the Scantlings of Timber for different purposes, the Specific Gravities of Materials, &c. By THOMAS TREDGOLD, C.E. Edited by PETER BARLOW, F.R.S. Fifth Edition, corrected and enlarged. With 64 Plates (11 of which now first appear in this edition), Portrait of the Author, and several Woodcuts. In 1 vol., 4to, published at 2*l.* 2*s.*, reduced to 1*l.* 5*s.*, cloth.

"'Tredgold's Carpentry' ought to be in every architect's and every builder's library, and those who do not already possess it ought to avail themselves of the new issue."—*Builder.*

"A work whose monumental excellence must commend it wherever skilful carpentry is concerned. The Author's principles are rather confirmed than impaired by time, and, as now presented, combine the surest base with the most interesting display of progressive science. The additional plates are of great intrinsic value."—*Building News.*

Grandy's Timber Tables.

THE TIMBER IMPORTER'S, TIMBER MERCHANT'S, and BUILDER'S STANDARD GUIDE. By RICHARD E. GRANDY. Comprising:—An Analysis of Deal Standards, Home and Foreign, with comparative Values and Tabular Arrangements for Fixing Nett Landed Cost on Baltic and North American Deals, including all intermediate Expenses, Freight, Insurance, &c., &c.; together with Copious Information for the Retailer and Builder. Second Edition. Carefully revised and corrected. 12mo, price 3*s.* 6*d.* cloth.

"Everything it pretends to be: built up gradually, it leads one from a forest to a treenail, and throws in, as a makeweight, a host of material concerning bricks, columns, cisterns, &c.—all that the class to whom it appeals requires."—*English Mechanic.*

"The only difficulty we have is as to what is NOT in its pages. What we have tested of the contents, taken at random, is invariably correct."—*Illustrated Builder's Journal.*

Tables for Packing-Case Makers.

PACKING-CASE TABLES; showing the number of Superficial Feet in Boxes or Packing-Cases, from six inches square and upwards. Compiled by WILLIAM RICHARDSON, Accountant. Oblong 4to, cloth, price 3*s.* 6*d.*

"Will save much labour and calculation to packing-case makers and those who use packing-cases."—*Grocer.* "Invaluable labour-saving tables."—*Ironmonger.*

Nicholson's Carpenter's Guide.

THE CARPENTER'S NEW GUIDE; or, BOOK of LINES for CARPENTERS: comprising all the Elementary Principles essential for acquiring a knowledge of Carpentry. Founded on the late PETER NICHOLSON'S standard work. A new Edition, revised by ARTHUR ASHPITEL, F.S.A., together with Practical Rules on Drawing, by GEORGE PYNE. With 74 Plates, 4to, 1*l.* 1*s.* cloth.

Dowsing's Timber Merchant's Companion.

THE TIMBER MERCHANT'S AND BUILDER'S COMPANION; containing New and Copious Tables of the Reduced Weight and Measurement of Deals and Battens, of all sizes, from One to a Thousand Pieces, and the relative Price that each size bears per Lineal Foot to any given Price per Petersburgh Standard Hundred; the Price per Cube Foot of Square Timber to any given Price per Load of 50 Feet; the proportionate Value of Deals and Battens by the Standard, to Square Timber by the Load of 50 Feet; the readiest mode of ascertaining the Price of Scantling per Lineal Foot of any size, to any given Figure per Cube Foot. Also a variety of other valuable information. By WILLIAM DOWSING, Timber Merchant. Third Edition, Revised and Corrected. Crown 8vo, 3*s.* cloth.

"Everything is as concise and clear as it can possibly be made. There can be no doubt that every timber merchant and builder ought to possess it."—*Hull Advertiser.*

Timber Freight Book.

THE TIMBER IMPORTERS' AND SHIPOWNERS' FREIGHT BOOK: Being a Comprehensive Series of Tables for the Use of Timber Importers, Captains of Ships, Shipbrokers, Builders, and all Dealers in Wood whatsoever. By WILLIAM RICHARDSON, Timber Broker. Crown 8vo, cloth, price 6*s.*

Horton's Measurer.

THE COMPLETE MEASURER; setting forth the Measurement of Boards, Glass, &c., &c.; Unequal-sided, Square-sided, Octagonal-sided, Round Timber and Stone, and Standing Timber. With just allowances for the bark in the respective species of trees, and proper deductions for the waste in hewing the trees, &c.; also a Table showing the solidity of hewn or eight-sided timber, or of any octagonal-sided column. Compiled for the accommodation of Timber-growers, Merchants, and Surveyors, Stonemasons, Architects, and others. By RICHARD HORTON. Third edition, with considerable and valuable additions, 12mo, strongly bound in leather, 5*s.*

"Not only are the best methods of measurement shown, and in some instances illustrated by means of woodcuts, but the erroneous systems pursued by dishonest dealers are fully exposed. . . . . The work must be considered to be a valuable addition to every gardener's library.—*Garden.*

Superficial Measurement.

THE TRADESMAN'S GUIDE TO SUPERFICIAL MEASUREMENT. Tables calculated from 1 to 200 inches in length, by 1 to 108 inches in breadth. For the use of Architects, Surveyors, Engineers, Timber Merchants, Builders, &c. By JAMES HAWKINGS. Fcp. 3*s.* 6*d.* cloth.

Practical Timber Merchant.

THE PRACTICAL TIMBER MERCHANT, being a Guide for the use of Building Contractors, Surveyors, Builders, &c., comprising useful Tables for all purposes connected with the Timber Trade, Marks of Wood, Essay on the Strength of Timber, Remarks on the Growth of Timber, &c. By W. RICHARDSON. Fcap. 8vo, 3*s.* 6*d.*, cloth. [*Just published.*

The Mechanic's Workshop Companion.

THE OPERATIVE MECHANIC'S WORKSHOP COMPANION, and THE SCIENTIFIC GENTLEMAN'S PRACTICAL ASSISTANT. By WILLIAM TEMPLETON. Twelfth Edition, with Mechanical Tables for Operative Smiths, Millwrights, Engineers, &c.; and an Extensive Table of Powers and Roots, &c., &c. 11 Plates. 12mo, 5*s.* bound.

"As a text-book of reference, in which mechanical and commercial demands are judiciously met, TEMPLETON'S COMPANION stands unrivalled."—*Mechanics' Magazine.*

"Admirably adapted to the wants of a very large class. It has met with great success in the engineering workshop, as we can testify; and there are a great many men who, in a great measure, owe their rise in life to this little work."—*Building News.*

Engineer's Assistant.

THE ENGINEER'S, MILLWRIGHT'S, and MACHINIST'S PRACTICAL ASSISTANT; comprising a Collection of Useful Tables, Rules, and Data. Compiled and Arranged, with Original Matter, by WILLIAM TEMPLETON. 5th Edition. 18mo, 2*s.* 6*d.* cloth.

"So much varied information compressed into so small a space, and published at a price which places it within the reach of the humblest mechanic, cannot fail to command the sale which it deserves. With the utmost confidence we commend this book to the attention of our readers.—*Mechanics' Magazine.*

"A more suitable present to an apprentice to any of the mechanical trades could not possibly be made.'—*Building News.*

Designing, Measuring, and Valuing.

THE STUDENT'S GUIDE to the PRACTICE of MEASURING, and VALUING ARTIFICERS' WORKS; containing Directions for taking Dimensions, Abstracting the same, and bringing the Quantities into Bill, with Tables of Constants, and copious Memoranda for the Valuation of Labour and Materials in the respective Trades of Bricklayer and Slater, Carpenter and Joiner, Painter and Glazier, Paperhanger, &c. With 43 Plates and Woodcuts. Originally edited by EDWARD DOBSON, Architect. New Edition, re-written, with Additions on Mensuration and Construction, and useful Tables for facilitating Calculations and Measurements. By E. WYNDHAM TARN, M.A., 8vo, 10*s.* 6*d.* cloth.

"We have failed to discover anything connected with the building trade, from excavating foundations to bell-hanging, that is not fully treated upon."—*The Artizan.*

"Altogether the book is one which well fulfils the promise of its title-page, and we can thoroughly recommend it to the class for whose use it has been compiled. Mr. Tarn's additions and revisions have much increased the usefulness of the work, and have especially augmented its value to students."—*Engineering.*

Plumbing.

PLUMBING; a text-book to the practice of the art or craft of the plumber. With supplementary chapters upon house-drainage, embodying the latest improvements. By WILLIAM PATON BUCHAN, Sanitary Engineer. 12mo. cloth, with about 300 illustrations. Price 3*s.* 6*d.* Just published.

"There is no other manual in existence of the plumber's art; and the volume will be welcomed as the work of a practical master of his trade."—*Public Health.*

"The chapters on house-drainage may be usefully consulted, not only by plumbers, but also by engineers and all engaged or interested in house-building."—*Iron.*

"A book containing a large amount of practical information, put together in a very *intelligent* manner, by one who is well qualified for the task."—*City Press.*

MATHEMATICS, &c.

Gregory's Practical Mathematics.

MATHEMATICS for PRACTICAL MEN; being a Commonplace Book of Pure and Mixed Mathematics. Designed chiefly for the Use of Civil Engineers, Architects, and Surveyors. Part I. PURE MATHEMATICS—comprising Arithmetic, Algebra, Geometry, Mensuration, Trigonometry, Conic Sections, Properties of Curves. Part II. MIXED MATHEMATICS—comprising Mechanics in general, Statics, Dynamics, Hydrostatics, Hydrodynamics, Pneumatics, Mechanical Agents, Strength of Materials. With an Appendix of copious Logarithmic and other Tables. By OLINTHUS GREGORY, LL.D., F.R.A.S. Enlarged by HENRY LAW, C.E. 4th Edition, carefully revised and corrected by J. R. YOUNG, formerly Professor of Mathematics, Belfast College; Author of "A Course of Mathematics," &c. With 13 Plates. Medium 8vo, *1l.* 1*s.* cloth.

"As a standard work on mathematics it has not been excelled."—*Artisan.*

"The engineer or architect will here find ready to his hand, rules for solving nearly every mathematical difficulty that may arise in his practice. The rules are in all cases explained by means of examples, in which every step of the process is clearly worked out."—*Builder.*

"One of the most serviceable books to the practical mechanics of the country. . . . . In the edition just brought out, the work has again been revised by Professor Young. He has modernised the notation throughout, introduced a few paragraphs here and there, and corrected the numerous typographical errors which have escaped the eyes of the former Editor. The book is now as complete as it is possible to make it. It is an instructive book for the student, and a Text-book for him who having once mastered the subjects it treats of, needs occasionally to refresh his memory upon them."—*Building News.*

The Metric System.

A SERIES OF METRIC TABLES, in which the British Standard Measures and Weights are compared with those of the Metric System at present in use on the Continent. By C. H. DOWLING, C. E. Second Edition, revised and enlarged. 8vo, 10*s.* 6*d.* strongly bound.

"Mr. Dowling's Tables, which are well put together, come just in time as a ready reckoner for the conversion of one system into the other."—*Athenæum.*

"Their accuracy has been certified by Prof. Airy, Astronomer-Royal."—*Builder.*

"Resolution 8.—That advantage will be derived from the recent publication of Metric Tables, by C. H. Dowling, C.E."—*Report of Section F, Brit. Assoc., Bath.*

Comprehensive Weight Calculator.

THE WEIGHT CALCULATOR; being a Series of Tables upon a New and Comprehensive Plan, exhibiting at one Reference the exact Value of any Weight from 1lb. to 15 tons, at 300 Progressive Rates, from 1 Penny to 168 Shillings per cwt., and containing 186,000 Direct Answers, which with their Combinations, consisting of a single addition (mostly to be performed at sight), will afford an aggregate of 10,266,000 Answers; the whole being calculated and designed to ensure Correctness and promote Despatch. By HENRY HARBEN, Accountant, Sheffield, Author of 'The Discount Guide.' An entirely New Edition, carefully revised. Royal 8vo, strongly half-bound, 30*s.* [*Just Published.*

Comprehensive Discount Guide.

THE DISCOUNT GUIDE: comprising several Series of Tables for the use of Merchants, Manufacturers, Ironmongers, and others, by which may be ascertained the exact profit arising from any mode of using Discounts, either in the Purchase or Sale of Goods, and the method of either Altering a Rate of Discount, or Advancing a Price, so as to produce, by one operation, a sum that will realise any required profit after allowing one or more Discounts: to which are added Tables of Profit or Advance from 1¼ to 90 per cent., Tables of Discount from 1¼ to 98¾ per cent., and Tables of Commission, &c., from ⅛ to 10 per cent. By HENRY HARBEN, Accountant, Author of "The Weight Calculator." New Edition, carefully Revised and Corrected. In a handsome demy 8vo. volume (544 pp.), strongly and elegantly half-bound, price £1 5*s*. [*Just published.*

Inwood's Tables, greatly enlarged and improved.

TABLES FOR THE PURCHASING of ESTATES, Freehold, Copyhold, or Leasehold; Annuities, Advowsons, &c., and for the Renewing of Leases held under Cathedral Churches, Colleges, or other corporate bodies; for Terms of Years certain, and for Lives; also for Valuing Reversionary Estates, Deferred Annuities, Next Presentations, &c., together with Smart's Five Tables of Compound Interest, and an Extension of the same to Lower and Intermediate Rates. By WILLIAM INWOOD, Architect. The 20th edition, with considerable additions, and new and valuable Tables of Logarithms for the more Difficult Computations of the Interest of Money, Discount, Annuities, &c., by M. FÉDOR THOMAN, of the Société Crédit Mobilier of Paris. 12mo, 8*s*. cloth.

"Those interested in the purchase and sale of estates, and in the adjustment of compensation cases, as well as in transactions in annuities, life insurances, &c., will find the present edition of eminent service."—*Engineering.*

"'Inwood's Tables' still maintain a most enviable reputation. The new issue has been enriched by large additional contributions by M. Fédor Thoman, whose carefully arranged Tables of Logarithms for the more Difficult Computations of the Interest of Money, Discount, Annuities, &c., cannot fail to be of the utmost utility."—*Mining Journal.*

Geometry for the Architect, Engineer, &c.

PRACTICAL GEOMETRY, for the Architect, Engineer, and Mechanic; giving Rules for the Delineation and Application of various Geometrical Lines, Figures and Curves. By E. W. TARN, M.A., Architect, Author of "The Science of Building," &c. With 164 Illustrations. Demy 8vo. 12*s*. 6*d*.

"No book with the same objects in view has ever been published in which the clearness of the rules laid down and the illustrative diagrams have been so satisfactory."—*Scotsman.*

Compound Interest and Annuities.

THEORY of COMPOUND INTEREST and ANNUITIES; with Tables of Logarithms for the more Difficult Computations of Interest, Discount, Annuities, &c., in all their Applications and Uses for Mercantile and State Purposes. With an elaborate Introduction. By FÉDOR THOMAN, of the Société Crédit Mobilier, Paris. 12mo, cloth, 5*s*.

"A very powerful work, and the Author has a very remarkable command of his subject."—*Professor A. de Morgan.*

"We recommend it to the notice of actuaries and accountants."—*Athenæum.*

SCIENCE AND ART.

The Military Sciences.

AIDE-MÉMOIRE to the MILITARY SCIENCES. Framed from Contributions of Officers and others connected with the different Services. Originally edited by a Committee of the Corps of Royal Engineers. Second Edition, most carefully revised by an Officer of the Corps, with many additions; containing nearly 350 Engravings and many hundred Woodcuts. 3 vols. royal 8vo, extra cloth boards, and lettered, price 4*l.* 10*s.*

"A compendious encyclopædia of military knowledge."—*Edinburgh Review.*

"The most comprehensive work of reference to the military and collateral sciences."—*Volunteer Service Gazette.*

Field Fortification.

A TREATISE on FIELD FORTIFICATION, the ATTACK of FORTRESSES, MILITARY MINING, and RECONNOITRING. By Colonel I. S. MACAULAY, late Professor of Fortification in the R. M. A., Woolwich. Sixth Edition, crown 8vo, cloth, with separate Atlas of 12 Plates, price 12*s.* complete.

Field Fortification.

HANDBOOK OF FIELD FORTIFICATION, intended for the Guidance of Officers preparing for Promotion, and especially adapted to the requirements of Beginners. By Major W. W. KNOLLYS, F.R.G.S., 93rd Sutherland Highlanders, &c. With 163 Woodcuts. Crown 8vo, 3*s.* 6*d.* cloth.

Storms.

STORMS: their Nature, Classification, and Laws, with the Means of Predicting them by their Embodiments, the Clouds. By WILLIAM BLASIUS. With Coloured Plates and numerous Wood Engravings. Crown 8vo, 10*s.* 6*d.* cloth boards.

Light-Houses.

EUROPEAN LIGHT-HOUSE SYSTEMS; being a Report of a Tour of Inspection made in 1873. By Major GEORGE H. ELLIOT, Corps of Engineers, U.S.A. Illustrated by 51 Engravings and 31 Woodcuts in the Text. 8vo, 21*s.* cloth.

Dye-Wares and Colours.

THE MANUAL of COLOURS and DYE-WARES: their Properties, Applications, Valuation, Impurities, and Sophistications. For the Use of Dyers, Printers, Dry Salters, Brokers, &c. By J. W. SLATER. Post 8vo, cloth, price 7*s.* 6*d.*

"A complete encyclopædia of the *materia tinctoria.* The information given respecting each article is full and precise, and the methods of determining the value of articles such as these, so liable to sophistication, are given with clearness, and are practical as well as valuable."—*Chemist and Druggist.*

Electricity.

A MANUAL of ELECTRICITY; including Galvanism, Magnetism, Diamagnetism, Electro-Dynamics, Magno-Electricity, and the Electric Telegraph. By HENRY M. NOAD, Ph.D., F.C.S., Lecturer on Chemistry at St. George's Hospital. Fourth Edition, entirely rewritten. Illustrated by 500 Woodcuts. 8vo, *1l. 4s.* cloth.

"The commendations already bestowed in the pages of the *Lancet* on the former editions of this work are more than ever merited by the present. The accounts given of electricity and galvanism are not only complete in a scientific sense, but, which is a rarer thing, are popular and interesting."—*Lancet.*

Text-Book of Electricity.

THE STUDENT'S TEXT-BOOK OF ELECTRICITY. By HENRY M. NOAD, Ph.D., Lecturer on Chemistry at St. George's Hospital. New Edition, revised and enlarged, with additions on Telegraphy, by G. E. PREECE, Esq. Upwards of 400 Illustrations.

[*In Preparation.*

Rudimentary Magnetism.

RUDIMENTARY MAGNETISM: being a concise exposition of the general principles of Magnetical Science, and the purposes to which it has been applied. By Sir W. SNOW HARRIS, F.R.S. New and enlarged Edition, with considerable additions by Dr. NOAD, Ph.D. With 165 Woodcuts. 12mo, cloth, *4s. 6d.*

"As concise and lucid an exposition of the phenomena of magnetism as we believe it is possible to write."—*English Mechanic.*

"Not only will the scientific student find this volume an invaluable book of reference, but the general reader will find in it as much to interest as to inform his mind. Though a strictly scientific work, its subject is handled in a simple and readable style."—*Illustrated Review.*

"There is a good index, and this volume of 412 pages may be considered the best possible manual on the subject of magnetism."—*Mechanics' Magazine.*

Chemical Analysis.

THE COMMERCIAL HANDBOOK of CHEMICAL ANALYSIS; or Practical Instructions for the determination of the Intrinsic or Commercial Value of Substances used in Manufactures, in Trades, and in the Arts. By A. NORMANDY, Author of "Practical Introduction to Rose's Chemistry," and Editor of Rose's "Treatise on Chemical Analysis." *New Edition.* Enlarged, and to a great extent re-written, by HENRY M. NOAD, Ph. D., F.R.S. With numerous Illustrations. Cr. 8vo, *12s. 6d.* cloth.

"We recommend this book to the careful perusal of every one; it may be truly affirmed to be of universal interest, and we strongly recommend it to our readers as a guide, alike indispensable to the housewife as to the pharmaceutical practitioner."—*Medical Times.*

"Will be found to be essential to the analysts appointed under the new Act. . . . In all cases the most recent results are given, and the work is well edited and carefully written."—*Nature.*

Mollusca.

A MANUAL OF THE MOLLUSCA; being a Treatise on Recent and Fossil Shells. By Dr. S. P. WOODWARD, A.L.S. With Appendix by RALPH TATE, A.L.S. F.G.S. With numerous Plates and 300 Woodcuts. Third Edition. Crown 8vo, *7s. 6d.* cloth gilt.

Clocks, Watches, and Bells.

RUDIMENTARY TREATISE on CLOCKS, and WATCHES, and BELLS. By Sir EDMUND BECKETT, Bart. (late E. B. Denison), LL.D., Q.C., F.R.A.S., Author of "Astronomy without Mathematics," &c. Sixth edition, thoroughly revised and enlarged, with numerous Illustrations. Limp cloth (No. 67, Weale's Series), 4*s.* 6*d.*; cloth boards, 5*s.* 6*d.*

"As a popular and practical treatise it is unapproached."—*English Mechanic.*

"The best work on the subject probably extant So far as we know it has no competitor worthy of the name. The treatise on bells is undoubtedly the best in the language. It shows that the author has contributed very much to their modern improvement, if indeed he has not revived this art, which was decaying here. To call it a rudimentary treatise is a misnomer, at least as respects clocks and bells. It is something more. It is the most important work of its kind in English."—*Engineering.*

"The only modern treatise on clock-making."—*Horological Journal.*

"We do not know whether to wonder most at the extraordinary cheapness of this admirable treatise on clocks, by the most able authority on such a subject, or the thorough completeness of his work. The chapter on bells is singular and amusing, and will be a real treat even to the uninitiated general reader. The illustrations, notes, and indices, make the work completely perfect of its kind."—*Standard.*

"There is probably no book in the English language on a technical subject so easy to read, and to read through, as the treatise on clocks, watches, and bells, written by the eminent Parliamentary Counsel, Mr. E. B. Denison—now Sir Edmund Beckett, Bart."—*Architect.*

Gold and Gold-Working.

THE PRACTICAL GOLD-WORKER; or, The Goldsmith's and Jeweller's Instructor. The Art of Alloying, Melting, Reducing, Colouring, Collecting and Refining. The processes of Manipulation, Recovery of Waste, Chemical and Physical Properties of Gold, with a new System of Mixing its Alloys; Solders, Enamels, and other useful Rules and Recipes, &c. By GEORGE E. GEE. Crown 8vo, cloth, 7*s.* 6*d.* [*Now Ready.*

"A good, sound, technical educator, and will be generally accepted as an authority. It gives full particulars for mixing alloys and enamels, is essentially a book for the workshop, and exactly fulfils the purpose intended."—*Horological Journal.*

"The best work yet printed on its subject for a reasonable price. We have no doubt that it will speedily become a standard book which few will care to be without."—*Jeweller and Metalworker.*

Science and Scripture.

SCIENCE ELUCIDATIVE OF SCRIPTURE, AND NOT ANTAGONISTIC TO IT; being a Series of Essays on—1. Alleged Discrepancies; 2. The Theory of the Geologists and Figure of the Earth; 3. The Mosaic Cosmogony; 4. Miracles in general—Views of Hume and Powell; 5. The Miracle of Joshua—Views of Dr. Colenso: The Supernaturally Impossible; 6. The Age of the Fixed Stars—their Distances and Masses. By Professor J. R. YOUNG, Author of "A Course of Elementary Mathematics," &c. &c. Fcap. 8vo, price 5*s.* cloth lettered.

"Distinguished by the true spirit of scientific inquiry, by great knowledge, by keen logical ability, and by a style peculiarly clear, easy, and energetic."—*Nonconformist.*

"No one can rise from its perusal without being impressed with a sense of the singular weakness of modern scepticism."—*Baptist Magazine.*

"A valuable contribution to controversial theological literature."—*City Press.*

Practical Philosophy.

A SYNOPSIS of PRACTICAL PHILOSOPHY. By the Rev. JOHN CARR, M.A., late Fellow of Trin. Coll., Cambridge. Second Edition. 18mo, 5*s.* cloth.

DR. LARDNER'S POPULAR WORKS.

Dr. Lardner's Museum of Science and Art.

THE MUSEUM OF SCIENCE AND ART. Edited by DIONYSIUS LARDNER, D.C.L., formerly Professor of Natural Philosophy and Astronomy in University College, London. With upwards of 1200 Engravings on Wood. In 6 Double Volumes. Price £1 1*s*., in a new and elegant cloth binding, or handsomely bound in half morocco, 31*s*. 6*d*.

"The 'Museum of Science and Art' is the most valuable contribution that has ever been made to the Scientific Instruction of every class of society."—*Sir David Brewster in the North British Review.*

"Whether we consider the liberality and beauty of the illustrations, the charm of the writing, or the durable interest of the matter, we must express our belief that there is hardly to be found among the new books, one that would be welcomed by people of so many ages and classes as a valuable present."—*Examiner.*

*** *Separate books formed from the above, suitable for Workmen's Libraries, Science Classes, &c.*

COMMON THINGS EXPLAINED. Containing Air, Earth, Fire, Water, Time, Man, the Eye, Locomotion, Colour, Clocks and Watches, &c. 233 Illustrations, cloth gilt, 5*s*.

THE MICROSCOPE. Containing Optical Images, Magnifying Glasses, Origin and Description of the Microscope, Microscopic Objects, the Solar Microscope, Microscopic Drawing and Engraving, &c. 147 Illustrations, cloth gilt, 2*s*.

POPULAR GEOLOGY. Containing Earthquakes and Volcanoes, the Crust of the Earth, etc. 201 Illustrations, cloth gilt, 2*s*. 6*d*.

POPULAR PHYSICS. Containing Magnitude and Minuteness, the Atmosphere, Meteoric Stones, Popular Fallacies, Weather Prognostics, the Thermometer, the Barometer, Sound, &c. 85 Illustrations, cloth gilt, 2*s*. 6*d*.

STEAM AND ITS USES. Including the Steam Engine, the Locomotive, and Steam Navigation. 89 Illustrations, cloth gilt, 2*s*.

POPULAR ASTRONOMY. Containing How to Observe the Heavens. The Earth, Sun, Moon, Planets. Light, Comets, Eclipses, Astronomical Influences, &c. 182 Illustrations, 4*s*. 6*d*.

THE BEE AND WHITE ANTS: Their Manners and Habits. With Illustrations of Animal Instinct and Intelligence. 135 Illustrations, cloth gilt, 2*s*.

THE ELECTRIC TELEGRAPH POPULARISED. To render intelligible to all who can Read, irrespective of any previous Scientific Acquirements, the various forms of Telegraphy in Actual Operation. 100 Illustrations, cloth gilt, 1*s*. 6*d*.

Scientific Class-Books, by Dr. Lardner.

NATURAL PHILOSOPHY FOR SCHOOLS. By DR. LARDNER. 328 Illustrations. Fifth Edition. 1 vol. 3*s*. 6*d*. cloth.

"Conveys, in clear and precise terms, general notions of all the principal divisions of Physical Science."—*British Quarterly Review.*

ANIMAL PHYSIOLOGY FOR SCHOOLS. By DR. LARDNER. With 190 Illustrations. Second Edition. 1 vol. 3*s*. 6*d*. cloth.

"Clearly written, well arranged, and excellently illustrated."—*Gardeners' Chronicle.*

DR. LARDNER'S SCIENTIFIC WORKS.

Astronomy.

THE HANDBOOK OF ASTRONOMY. 4th Edition. Edited by EDWIN DUNKIN, F.R.S., Rl. Observatory, Greenwich. With 38 plates and upwards of 100 Woodcuts. Cr. 8vo, 9*s.* 6*d.* cloth.

"Probably no other book contains the same amount of information in so compendious and well-arranged a form."—*Athenæum.*

Animal Physics.

THE HANDBOOK OF ANIMAL PHYSICS. With 520 Illustrations. New edition, small 8vo, cloth, 7*s.* 6*d.* 732 pages.

"We have no hesitation in cordially recommending it."—*Educational Times.*

Electric Telegraph.

THE ELECTRIC TELEGRAPH. New Edition. By E. B. BRIGHT, F.R.A.S. 140 Illustrations. Small 8vo, 2*s.* 6*d.* cloth.

"One of the most readable books extant on the Electric Telegraph."—*Eng. Mechanic.*

LARDNER'S COURSE OF NATURAL PHILOSOPHY.

Mechanics.

THE HANDBOOK OF MECHANICS. Enlarged and almost rewritten by BENJAMIN LOEWY, F.R.A.S. With 378 Illustrations. Post 8vo, 6*s.* cloth.

"The perspicuity of the original has been retained, and chapters which had become obsolete, have been replaced by others of more modern character. The explanations throughout are studiously popular, and care has been taken to show the application of the various branches of physics to the industrial arts, and to the practical business of life."—*Mining Journal.*

Heat.

THE HANDBOOK OF HEAT. Edited and almost entirely Re-written by BENJAMIN LOEWY, F.R.A.S. etc. 117 Illustrations. Post 8vo, 6*s.* cloth. [*Just published.*

"The style is always clear and precise, and conveys instruction without leaving any cloudiness or lurking doubts behind."—*Engineering.*

Hydrostatics and Pneumatics.

THE HANDBOOK of HYDROSTATICS and PNEUMATICS. New Edition, Revised and Enlarged by BENJAMIN LOEWY, F.R.A.S. With 236 Illustrations. Post 8vo, 5*s.* cl. [*Just published.*

"For those 'who desire to attain an accurate knowledge of physical science without the profound methods of mathematical investigation,' this work is not merely intended, but well adapted."—*Chemical News.*

Electricity, Magnetism, and Acoustics.

THE HANDBOOK of ELECTRICITY, MAGNETISM, and ACOUSTICS. New Edition. Edited by GEO. CAREY FOSTER, B.A., F.C.S. With 400 Illustrations. Post 8vo, 5*s.* cloth.

"The book could not have been entrusted to any one better calculated to preserve the terse and lucid style of Lardner, while correcting his errors and bringing up his work to the present state of scientific knowledge."—*Popular Science Review.*

Optics.

THE HANDBOOK OF OPTICS. New Edition. Edited by T. OLVER HARDING, B.A. 298 Illustrations. Post 8vo, 5*s.* cloth.

"Written by one of the ablest English scientific writers, beautifully and elaborately illustrated."—*Mechanic's Magazine.*

*** *The above* 5 *Vols. form* A COMPLETE COURSE OF NATURAL PHILOSOPHY.

Geology and Genesis Harmonised.

THE TWIN RECORDS of CREATION; or, Geology and Genesis, their Perfect Harmony and Wonderful Concord. By GEORGE W. VICTOR LE VAUX. With numerous Illustrations. Fcap. 8vo, price 5*s.* cloth.

"We can recommend Mr. Le Vaux as an able and interesting guide to a popular appreciation of geological science."—*Spectator.*

"The author combines an unbounded admiration of science with an unbounded admiration of the Written Record."—*London Review.*

Geology, Physical.

PHYSICAL GEOLOGY. (Partly based on Major-General Portlock's Rudiments of Geology.) By RALPH TATE, A.L.S., F.G.S. Numerous Woodcuts. 12mo, 2*s.*

Geology, Historical.

HISTORICAL GEOLOGY. (Partly based on Major-General Portlock's Rudiments of Geology.) By RALPH TATE, A.L.S., F.G.S. Numerous Woodcuts. 12mo, 2*s.* 6*d.*

*** *Or* PHYSICAL *and* HISTORICAL GEOLOGY, *bound in One Volume, price* 5*s.*

Wood-Carving.

INSTRUCTIONS in WOOD-CARVING, for Amateurs; with Hints on Design. By A LADY. In emblematic wrapper, handsomely printed, with Ten large Plates, price 2*s.* 6*d.*

"The handicraft of the wood-carver, so well as a book can impart it, may be learnt from 'A Lady's' publication."—*Athenæum.*

"A real *practical guide.* It is very complete."—*Literary Churchman.*

"The directions given are plain and easily understood, and it forms a very good introduction to the practical part of the carver's art."—*English Mechanic.*

Popular Work on Painting.

PAINTING POPULARLY EXPLAINED; with Historical Sketches of the Progress of the Art. By THOMAS JOHN GULLICK, Painter, and JOHN TIMBS, F.S.A. Second Edition, revised and enlarged. With Frontispiece and Vignette. In small 8vo, 6*s.* cloth.

*** *This Work has been adopted as a Prize-book in the Schools of Art at South Kensington.*

"A work that may be advantageously consulted. Much may be learned, even by those who fancy they do not require to be taught, from the careful perusal of this unpretending but comprehensive treatise."—*Art Journal.*

"A valuable book, which supplies a want. It contains a large amount of original matter, agreeably conveyed, and will be found of value, as well by the young artist seeking information as by the general reader. We give a cordial welcome to the book, and augur for it an increasing reputation."—*Builder.*

Grammar of Colouring.

A GRAMMAR OF COLOURING, applied to Decorative Painting and the Arts. By GEORGE FIELD. New edition, enlarged and adapted to the use of the Ornamental Painter and Designer, by ELLIS A. DAVIDSON. With new Coloured Diagrams and numerous Engravings on Wood. 12mo, 3*s.* cloth boards.

"One of the most useful of student's books, and probably the best known of the few we have on the subject."—*Architect.*

"The book is a most useful *résumé* of the properties of pigments."—*Builder.*

"This treatise forms a most valuable *vade mecum* for the ornamental painter and designer."—*Scotsman.*

Delamotte's Works on Illumination & Alphabets.

A PRIMER OF THE ART OF ILLUMINATION; for the use of Beginners: with a Rudimentary Treatise on the Art, Practical Directions for its Exercise, and numerous Examples taken from Illuminated MSS., printed in Gold and Colours. By F. DELAMOTTE. Small 4to, price 9*s*. Elegantly bound, cloth antique.

"A handy book, beautifully illustrated; the text of which is well written, and calculated to be useful. . . . The examples of ancient MSS. recommended to the student which, with much good sense, the author chooses from collections accessible to all, are selected with judgment and knowledge, as well as taste."—*Athenæum.*

ORNAMENTAL ALPHABETS, ANCIENT and MEDIÆVAL; from the Eighth Century, with Numerals; including Gothic, Church-Text, large and small, German, Italian, Arabesque, Initials for Illumination, Monograms, Crosses, &c. &c., for the use of Architectural and Engineering Draughtsmen, Missal Painters, Masons, Decorative Painters, Lithographers, Engravers, Carvers, &c. &c. &c. Collected and engraved by F. DELAMOTTE, and printed in Colours. Royal 8vo, oblong, price 4*s*. cloth.

"A well-known engraver and draughtsman has enrolled in this useful book the result of many years' study and research. For those who insert enamelled sentences round gilded chalices, who blazon shop legends over shop-doors, who letter church walls with pithy sentences from the Decalogue, this book will be useful."—*Athenæum.*

EXAMPLES OF MODERN ALPHABETS, PLAIN and ORNAMENTAL; including German, Old English, Saxon, Italic, Perspective, Greek, Hebrew, Court Hand, Engrossing, Tuscan, Riband, Gothic, Rustic, and Arabesque; with several Original Designs, and an Analysis of the Roman and Old English Alphabets, large and small, and Numerals, for the use of Draughtsmen, Surveyors, Masons, Decorative Painters, Lithographers, Engravers, Carvers, &c. Collected and engraved by F. DELAMOTTE, and printed in Colours. Royal 8vo, oblong, price 4*s*. cloth.

"To artists of all classes, but more especially to architects and engravers, this very handsome book will be invaluable. There is comprised in it every possible shape into which the letters of the alphabet and numerals can be formed, and the talent which has been expended in the conception of the various plain and ornamental letters is wonderful."—*Standard.*

MEDIÆVAL ALPHABETS AND INITIALS FOR ILLUMINATORS. By F. DELAMOTTE, Illuminator, Designer, and Engraver on Wood. Containing 21 Plates, and Illuminated Title, printed in Gold and Colours. With an Introduction by J. WILLIS BROOKS. Small 4to, 6*s*. cloth gilt.

"A volume in which the letters of the alphabet come forth glorified in gilding and all the colours of the prism interwoven and intertwined and intermingled, sometimes with a sort of rainbow arabesque. A poem emblazoned in these characters would be only comparable to one of those delicious love letters symbolized in a bunch of flowers well selected and cleverly arranged."—*Sun.*

THE EMBROIDERER'S BOOK OF DESIGN; containing Initials, Emblems, Cyphers, Monograms, Ornamental Borders, Ecclesiastical Devices, Mediæval and Modern Alphabets, and National Emblems. Collected and engraved by F. DELAMOTTE, and printed in Colours. Oblong royal 8vo, 2*s*. 6*d*. in ornamental boards.

AGRICULTURE, &c.

Youatt and Burn's Complete Grazier.

THE COMPLETE GRAZIER, and FARMER'S and CATTLE-BREEDER'S ASSISTANT. A Compendium of Husbandry. By WILLIAM YOUATT, ESQ., V.S. 11th Edition, enlarged by ROBERT SCOTT BURN, Author of "The Lessons of My Farm," &c. One large 8vo volume, 784 pp. with 215 Illustrations. *1l. 1s.* half-bd.

"The standard and text-book, with the farmer and grazier."—*Farmer's Magazine*

"A treatise which will remain a standard work on the subject as long as British agriculture endures."—*Mark Lane Express.*

Spooner on Sheep.

SHEEP; THE HISTORY, STRUCTURE, ECONOMY, AND DISEASES OF. By W. C. SPOONER, M.R.V.C., &c. Third Edition, considerably enlarged; with numerous fine engravings, including some specimens of New and Improved Breeds. Fcp. 8vo, 366 pp., price 6*s.* cloth.

"The book is decidedly the best of the kind in our language."—*Scotsman.*

"Mr. Spooner has conferred upon the agricultural class a lasting benefit by embodying in this work the improvements made in sheep stock by such men as Humphreys, Rawlence, Howard, and others."—*Hampshire Advertiser.*

"The work should be in possession of every flock-master."—*Banbury Guardian.*

Scott Burn's System of Modern Farming.

OUTLINES OF MODERN FARMING. By R. SCOTT BURN. Soils, Manures, and Crops—Farming and Farming Economy, Historical and Practical—Cattle, Sheep, and Horses—Management of the Dairy, Pigs, and Poultry, with Notes on the Diseases of Stock—Utilisation of Town-Sewage, Irrigation, and Reclamation of Waste Land. New Edition. In 1 vol. 1250 pp., half-bound, profusely illustrated, price 12*s.*

"There is sufficient stated within the limits of this treatise to prevent a farmer from going far wrong in any of his operations."—*Observer.*

Horton's Underwood and Woodland Tables.

TABLES FOR PLANTING AND VALUING UNDERWOOD AND WOODLAND; also Lineal, Superficial, Cubical, Wages, Marketing, and Decimal Tables. Together with Tables for Converting Land-measure from one denomination to another, and instructions for Measuring Round Timber. By RICHARD HORTON. 12mo. 2*s.* strongly bound in leather.

Good Gardening.

A PLAIN GUIDE TO GOOD GARDENING; or, How to Grow Vegetables, Fruits, and Flowers. With Practical Notes on Soils, Manures, Seeds, Planting, Laying-out of Gardens and Grounds, and on the various kinds of Garden Structures. By SAMUEL WOOD (late gardener to Sir B. P. Wrey, Bart.), Author of 'Gardening for the Cottage.' Second Edition, with very considerable Additions, &c., and numerous Illustrations. Crown 8vo, pp. 416, cloth elegant, price 5*s.*

"A very good book, and one to be highly recommended as a practical guide. The practical directions are excellent."—*Athenæum.*

"A thoroughly useful guidebook for the amateur gardener who may want to make his plot of land not merely pretty, but useful and profitable."—*Daily Telegraph.*

Ewart's Land Improver's Pocket-Book.

THE LAND IMPROVER'S POCKET-BOOK OF FORMULÆ, TABLES, and MEMORANDA, required in any Computation relating to the Permanent Improvement of Landed Property. By JOHN EWART, Land Surveyor and Agricultural Engineer. Royal 32mo, oblong, leather, gilt edges, with elastic band, 4*s.*

"Admirably calculated to serve its purpose."—*Scotsman.*
"A compendious and handy little volume."—*Spectator.*

Hudson's Tables for Land Valuers.

THE LAND VALUER'S BEST ASSISTANT: being Tables, on a very much improved Plan, for Calculating the Value of Estates. With Tables for reducing Scotch, Irish, and Provincial Customary Acres to Statute Measure; also, Tables of Square Measure, and of the Dimensions of an Acre by which the Contents of any Plot of Ground may be ascertained without the expense of a regular Survey; &c. By R. HUDSON, C.E. New Edition, royal 32mo, oblong, leather, gilt edges, with elastic band, 4*s.*

"Of incalculable value to the country gentleman and professional man."—*Farmer's Journal.*

Complete Agricultural Surveyor's Pocket-Book.

THE LAND VALUER'S AND LAND IMPROVER'S COMPLETE POCKET-BOOK; consisting of the above two works bound together, leather, gilt edges, with strap, 7*s.* 6*d.*

☞ *The above forms an unequalled and most compendious Pocket Vade-mecum for the Land Agent and Agricultural Engineer.*

"We consider Hudson's book to be the best ready-reckoner on matters relating to the valuation of land and crops we have ever seen, and its combination with Mr. Ewart's work greatly enhances the value and usefulness of the latter-mentioned . . It is most useful as a manual for reference to those for whom it is intended."—*North of England Farmer.*

The Management of Estates.

LANDED ESTATES MANAGEMENT: Treating of the Varieties of Lands, Peculiarities of its Farms, Methods of Farming, the Setting-out of Farms and their Fields, Construction of Roads, Fences, Gates, and Farm Buildings, of Waste or Unproductive Lands, Irrigation, Drainage, Plantation, &c. By R. SCOTT BURN, Fcp. 8vo. numerous Illustrations, 3*s.* 6*d.* [*Now Ready.*

Scott Burn's Introduction to Farming.

THE LESSONS of MY FARM: a Book for Amateur Agriculturists, being an Introduction to Farm Practice, in the Culture of Crops, the Feeding of Cattle, Management of the Dairy, Poultry, and Pigs, and in the Keeping of Farm-work Records. By ROBERT SCOTT BURN. With numerous Illustrations. Fcp. 6*s.* cloth.

"A most complete introduction to the whole round of farming practice."—*John Bull.*

The Laws of Mines and Mining Companies.

A PRACTICAL TREATISE on the LAW RELATING to MINES and MINING COMPANIES. By WHITTON ARUNDELL, Attorney-at-Law. Crown 8vo, 4*s.* cloth.

"*A Complete Epitome of the Laws of this Country.*"

EVERY MAN'S OWN LAWYER; a Handy-Book of the Principles of Law and Equity. By A BARRISTER. 14th Edition, Revised to the end of last Session. Including a Summary of the Judicature Acts, and the principal Acts of the past Session, viz. —The Act for Amending the Law Relating to Crossed Cheques, The Merchant Shipping Act, The Vivisection or Cruelty to Animals Amendment Act, The Rivers' Pollution Prevention Act. The Wild-Fowl Preservation Act, &c., &c. With Notes and References to the Authorities. Crown 8vo, price 6*s.* 8*d.* (saved at every consultation), strongly bound.

COMPRISING THE LAWS OF

BANKRUPTCY—BILLS OF EXCHANGE—CONTRACTS AND AGREEMENTS—COPYRIGHT—DOWER AND DIVORCE—ELECTIONS AND REGISTRATION—INSURANCE—LIBEL AND SLANDER—MORTGAGES—SETTLEMENTS—STOCK EXCHANGE PRACTICE—TRADE MARKS AND PATENTS—TRESPASS, NUISANCES, ETC.—TRANSFER OF LAND, ETC.—WARRANTY—WILLS AND AGREEMENTS, ETC. Also Law for Landlord and Tenant—Master and Servant—Workmen and Apprentices—Heirs, Devisees, and Legatees—Husband and Wife—Executors and Trustees—Guardian and Ward—Married Women and Infants—Partners and Agents—Lender and Borrower—Debtor and Creditor—Purchaser and Vendor—Companies and Associations—Friendly Societies—Clergymen, Churchwardens—Medical Practitioners, &c.—Bankers—Farmers—Contractors—Stock and Share Brokers—Sportsmen and Gamekeepers—Farriers and Horse-Dealers—Auctioneers, House-Agents—Innkeepers, &c.—Pawnbrokers—Surveyors—Railways and Carriers, &c. &c.

"No Englishman ought to be without this book."—*Engineer.*

"What it professes to be—a complete epitome of the laws of this country, thoroughly intelligible to non-professional readers."—*Bell's Life.*

Auctioneer's Assistant.

THE APPRAISER, AUCTIONEER, BROKER, HOUSE AND ESTATE AGENT, AND VALUER'S POCKET ASSISTANT, for the Valuation for Purchase, Sale, or Renewal of Leases, Annuities, and Reversions, and of property generally; with Prices for Inventories, &c. By JOHN WHEELER, Valuer, &c. Third Edition, enlarged, by C. NORRIS. Royal 32mo, cloth, 5*s.*

"A neat and concise book of reference, containing an admirable and clearly-arranged list of prices for inventories, and a very practical guide to determine the value of furniture, &c."—*Standard.*

Pawnbroker's Legal Guide.

THE PAWNBROKER'S, FACTOR'S, and MERCHANT'S GUIDE to the LAW of LOANS and PLEDGES. By H. C. FOLKARD, Esq., Barrister-at-Law, Author of the "Law of Slander and Libel," &c. With Additions and Corrections to 1876. 12mo, cloth boards, price 3*s.* 6*d.*

House Property.

HANDBOOK OF HOUSE PROPERTY: a Popular and Practical Guide to the Purchase, Mortgage, Tenancy, and Compulsory Sale of Houses and Land; including the Law of Dilapidations and Fixtures; with Explanations and Examples of all kinds of Valuations, and useful Information and Advice on Building. By EDWARD LANCE TARBUCK, Architect and Surveyor. 12mo, 5*s.* cloth boards.

"We are glad to be able to recommend it."—*Builder.*

"The advice is thoroughly practical."—*Law Journal.*

Bradbury, Agnew & Co., Printers, Whitefriars, London.

Weale's Rudimentary Series

PHILADELPHIA, 1876.

THE PRIZE MEDAL

Was awarded to the Publishers for

Books: Rudimentary Scientific,

"WEALE'S SERIES," ETC.

A NEW LIST OF

WEALE'S SERIES

RUDIMENTARY SCIENTIFIC, EDUCATIONAL, AND CLASSICAL.

LONDON, 1862.

THE PRIZE MEDAL

Was awarded to the Publishers of

"WEALE'S SERIES."

These popular and cheap Series of Books, now comprising nearly Three Hundred distinct works in almost every department of Science, Art, and Education, are recommended to the notice of Engineers, Architects, Builders, Artisans, and Students generally, as well as to those interested in Workmen's Libraries, Free Libraries, Literary and Scientific Institutions, Colleges, Schools, Science Classes, &c., &c.

N.B.—In ordering from this List it is recommended, as a means of facilitating business and obviating error, to quote the numbers affixed to the volumes, as well as the titles and prices.

*** The books are bound in limp cloth, unless otherwise stated.

RUDIMENTARY SCIENTIFIC SERIES.

ARCHITECTURE, BUILDING, ETC.

No.

16. *ARCHITECTURE—ORDERS*—The Orders and their Æsthetic Principles. By W. H. Leeds. Illustrated. 1s. 6d.

17. *ARCHITECTURE—STYLES*—The History and Description of the Styles of Architecture of Various Countries, from the Earliest to the Present Period. By T. Talbot Bury, F.R.I.B.A., &c. Illustrated. 2s.

*** Orders and Styles of Architecture, *in One Vol.*, 3s. 6d.

18. *ARCHITECTURE—DESIGN*—The Principles of Design in Architecture, as deducible from Nature and exemplified in the Works of the Greek and Gothic Architects. By E. L. Garbett, Architect. Illustrated. 2s.

*** *The three preceding Works, in One handsome Vol., half bound, entitled* "Modern Architecture," *Price* 6s.

22. *THE ART OF BUILDING*, Rudiments of. General Principles of Construction, Materials used in Building, Strength and Use of Materials, Working Drawings, Specifications, and Estimates. By Edward Dobson, M.R.I.B.A., &c. Illustrated. 2s.

23. *BRICKS AND TILES*, Rudimentary Treatise on the Manufacture of; containing an Outline of the Principles of Brickmaking. By Edw. Dobson, M.R.I.B.A. With Additions by C. Tomlinson, F.R.S. Illustrated, 3s.

Architecture, Building, etc., *continued.*

25. *MASONRY AND STONECUTTING*, Rudimentary Treatise on; in which the Principles of Masonic Projection and their application to the Construction of Curved Wing-Walls, Domes, Oblique Bridges, and Roman and Gothic Vaulting, are concisely explained. By EDWARD DOBSON, M.R.I.B.A., &c. Illustrated with Plates and Diagrams. 2s. 6d.

44. *FOUNDATIONS AND CONCRETE WORKS*, a Rudimentary Treatise on; containing a Synopsis of the principal cases of Foundation Works, with the usual Modes of Treatment, and Practical Remarks on Footings, Planking, Sand, Concrete, Béton, Pile-driving, Caissons, and Cofferdams. By E. DOBSON, M.R.I.B.A., &c. Fourth Edition, revised by GEORGE DODD, C.E. Illustrated. 1s. 6d.

42. *COTTAGE BUILDING.* By C. BRUCE ALLEN, Architect. Eleventh Edition, revised and enlarged. Numerous Illustrations. 1s. 6d.

45. *LIMES, CEMENTS, MORTARS, CONCRETES, MASTICS,* PLASTERING, &c. By G. R. BURNELL, C.E. Ninth Edition. 1s. 6d.

57. *WARMING AND VENTILATION*, a Rudimentary Treatise on; being a concise Exposition of the General Principles of the Art of Warming and Ventilating Domestic and Public Buildings, Mines, Lighthouses, Ships, &c. By CHARLES TOMLINSON, F.R.S., &c. Illustrated. 3s.

83**. *CONSTRUCTION OF DOOR LOCKS.* Compiled from the Papers of A. C. HOBBS, Esq., of New York, and Edited by CHARLES TOMLINSON, F.R.S. To which is added, a Description of Fenby's Patent Locks, and a Note upon IRON SAFES by ROBERT MALLET, M.I.C.E. Illus. 2s. 6d.

111. *ARCHES, PIERS, BUTTRESSES, &c.:* Experimental Essays on the Principles of Construction in; made with a view to their being useful to the Practical Builder. By WILLIAM BLAND. Illustrated. 1s. 6d.

116. *THE ACOUSTICS OF PUBLIC BUILDINGS;* or, The Principles of the Science of Sound applied to the purposes of the Architect and Builder. By T. ROGER SMITH, M.R.I.B.A., Architect. Illustrated. 1s. 6d.

124. *CONSTRUCTION OF ROOFS*, Treatise on the, as regards Carpentry and Joinery. Deduced from the Works of ROBISON, PRICE, and TREDGOLD. Illustrated. 2s. 6d.

127. *ARCHITECTURAL MODELLING IN PAPER*, the Art of. By T. A. RICHARDSON, Architect. Illustrated. 1s. 6d.

128. *VITRUVIUS—THE ARCHITECTURE OF MARCUS VITRUVIUS POLLO.* In Ten Books. Translated from the Latin by JOSEPH GWILT, F.S.A., F.R.A.S. With 23 Plates. 5s.

130. *GRECIAN ARCHITECTURE*, An Inquiry into the Principles of Beauty in; with a Historical View of the Rise and Progress of the Art in Greece. By the EARL OF ABERDEEN. 1s.

*** *The two Preceding Works in One handsome Vol., half bound, entitled* "ANCIENT ARCHITECTURE." *Price 6s.*

132. *DWELLING-HOUSES*, a Rudimentary Treatise on the Erection of. By S. H. BROOKS, Architect. New Edition, with Plates. 2s. 6d.

156. *QUANTITIES AND MEASUREMENTS*, How to Calculate and Take them in Bricklayers', Masons', Plasterers', Plumbers', Painters', Paperhangers', Gilders', Smiths', Carpenters', and Joiners' Work. By A. C. BEATON, Architect and Surveyor. New and Enlarged Edition. Illus. 1s. 6d.

175. *LOCKWOOD & CO.'S BUILDER'S AND CONTRACTOR'S* PRICE BOOK, for 1877, containing the latest Prices of all kinds of Builders' Materials and Labour, and of all Trades connected with Building: Lists of the Members of the Metropolitan Board of Works, of Districts, District Officers, and District Surveyors, and the Metropolitan Bye-laws. Edited by FRANCIS T. W. MILLER, Architect and Surveyor. 3s. 6d.

182. *CARPENTRY AND JOINERY*—THE ELEMENTARY PRINCIPLES OF CARPENTRY. Chiefly composed from the Standard Work of THOMAS TREDGOLD, C.E. With Additions from the Works of the most Recent Authorities, and a TREATISE ON JOINERY by E. WYNDHAM TARN, M.A. Numerous Illustrations. 3s. 6d.

Architecture, Building, etc., *continued.*

182*. *CARPENTRY AND JOINERY. ATLAS* of 35 Plates to accompany the foregoing book. With Descriptive Letterpress. 4to. 6s.

187. *HINTS TO YOUNG ARCHITECTS.* By GEORGE WIGHTWICK. New, Revised, and enlarged Edition. By G. HUSKISSON GUILLAUME, Architect. With numerous Woodcuts. 3s. 6d.

188. *HOUSE PAINTING, GRAINING, MARBLING, AND SIGN WRITING:* A Practical Manual of. With 9 Coloured Plates of Woods and Marbles, and nearly 150 Wood Engravings. By ELLIS A. DAVIDSON. Second Edition, carefully revised, 5s. [*Just published.*

189. *THE RUDIMENTS OF PRACTICAL BRICKLAYING.* In Six Sections: General Principles; Arch Drawing, Cutting, and Setting; Pointing; Paving, Tiling, Materials; Slating and Plastering; Practical Geometry, Mensuration, &c. By ADAM HAMMOND. Illustrated. 1s. 6d.

191. *PLUMBING.* A Text-Book to the Practice of the Art or Craft of the Plumber. With Chapters upon House Drainage, embodying the latest Improvements. Containing about 300 Illustrations. By W. P. BUCHAN, Sanitary Engineer. 3s. [*Just published.*

192. *THE TIMBER IMPORTER'S, TIMBER MERCHANT'S,* and BUILDER'S STANDARD GUIDE; comprising copious and valuable Memoranda for the Retailer and Builder. By RICHARD E. GRANDY. Second Edition, Revised. 3s.

CIVIL ENGINEERING, ETC.

13. *CIVIL ENGINEERING*, the Rudiments of; for the Use of Beginners, for Practical Engineers, and for the Army and Navy. By HENRY LAW, C.E. Including a Section on Hydraulic Engineering, by GEORGE R. BURNELL, C.E. 5th Edition, with Notes and Illustrations by ROBERT MALLET, A.M., F.R.S. Illustrated with Plates and Diagrams. 5s.

29. *THE DRAINAGE OF DISTRICTS AND LANDS.* By G. DRYSDALE DEMPSEY, C.E. New Edition, enlarged. Illustrated. 1s. 6d.

30. *THE DRAINAGE OF TOWNS AND BUILDINGS.* By G. DRYSDALE DEMPSEY, C.E. New Edition. Illustrated. 2s. 6d.
*** *With "Drainage of Districts and Lands," in One Vol., 3s. 6d.*

31. *WELL-DIGGING, BORING, AND PUMP-WORK.* By JOHN GEORGE SWINDELL, Assoc. R.I.B.A. New Edition, revised by G. R. BURNELL, C.E. Illustrated. 1s. 6d.

35. *THE BLASTING AND QUARRYING OF STONE*, for Building and other Purposes. With Remarks on the Blowing up of Bridges. By Gen. Sir JOHN BURGOYNE, Bart., K.C.B. Illustrated. 1s. 6d.

43. *TUBULAR AND OTHER IRON GIRDER BRIDGES.* Particularly describing the BRITANNIA and CONWAY TUBULAR BRIDGES. With a Sketch of Iron Bridges, and Illustrations of the Application of Malleable Iron to the Art of Bridge Building. By G. D. DEMPSEY, C.E. New Edition, with Illustrations. 1s. 6d.

62. *RAILWAY CONSTRUCTION*, Elementary and Practical Instruction on. By Sir MACDONALD STEPHENSON, C.E. New Edition, enlarged by EDWARD NUGENT, C.E. Plates and numerous Woodcuts. 3s.

80*. *EMBANKING LANDS FROM THE SEA*, the Practice of. Treated as a Means of Profitable Employment for Capital. With Examples and Particulars of actual Embankments, and also Practical Remarks on the Repair of old Sea Walls. By JOHN WIGGINS, F.G.S. New Edition, with Notes by ROBERT MALLET, F.R.S. 2s.

81. *WATER WORKS*, for the Supply of Cities and Towns. With a Description of the Principal Geological Formations of England as influencing Supplies of Water; and Details of Engines and Pumping Machinery for raising Water. By SAMUEL HUGHES, F.G.S., C.E. New Edition, revised and enlarged, with numerous Illustrations. 4s.

82**. *GAS WORKS*, and the Practice of Manufacturing and Distributing Coal Gas. By SAMUEL HUGHES, C.E. New Edition, revised by W RICHARDS, C.E. Illustrated. 3s. 6d.

Civil Engineering, etc., *continued.*

117. *SUBTERRANEOUS SURVEYING;* an Elementary and Practical Treatise on. By THOMAS FENWICK. Also the Method of Conducting Subterraneous Surveys without the Use of the Magnetic Needle, and other modern Improvements. By THOMAS BAKER, C.E. Illustrated. 2s. 6d.

118. *CIVIL ENGINEERING IN NORTH AMERICA,* a Sketch of. By DAVID STEVENSON, F.R.S.E., &c. Plates and Diagrams. 3s.

121. *RIVERS AND TORRENTS.* With the Method of Regulating their Courses and Channels. By Professor PAUL FRISI, F.R.S., of Milan. To which is added, AN ESSAY ON NAVIGABLE CANALS. Translated by Major-General JOHN GARSTIN, of the Bengal Engineers. Plates. 2s. 6d.

197. *ROADS AND STREETS (THE CONSTRUCTION OF),* in two Parts: I. THE ART OF CONSTRUCTING COMMON ROADS, by HENRY LAW, C.E., revised and condensed by D. KINNEAR CLARK, C.E.; II. RECENT PRACTICE IN THE CONSTRUCTION OF ROADS AND STREETS, including pavements of Stone, Wood, and Asphalte, by D. K. CLARK, M.I.C.E., with numerous Illustrations. 4s. 6d. [*Just published.*

MECHANICAL ENGINEERING, ETC.

33. *CRANES,* the Construction of, and other Machinery for Raising Heavy Bodies for the Erection of Buildings, and for Hoisting Goods. By JOSEPH GLYNN, F.R.S., &c. Illustrated. 1s. 6d.

34. *THE STEAM ENGINE,* a Rudimentary Treatise on. By Dr. LARDNER. Illustrated. 1s. 6d.

59. *STEAM BOILERS:* their Construction and Management. By R. ARMSTRONG, C.E. Illustrated. 1s. 6d.

63. *AGRICULTURAL ENGINEERING:* Farm Buildings, Motive Power, Field Machines, Machinery, and Implements. By G. H. ANDREWS, C.E. Illustrated. 3s.

67. *CLOCKS, WATCHES, AND BELLS,* a Rudimentary Treatise on. By Sir EDMUND BECKETT (late EDMUND BECKETT DENISON, LL.D., Q.C.). A new, Revised, and considerably Enlarged Edition (the 6th), with very numerous Illustrations. 4s. 6d. [*Just published.*

77*. *THE ECONOMY OF FUEL,* particularly with Reference to Reverbatory Furnaces for the Manufacture of Iron, and to Steam Boilers. By T. SYMES PRIDEAUX. 1s. 6d.

82. *THE POWER OF WATER,* as applied to drive Flour Mills, and to give motion to Turbines and other Hydrostatic Engines. By JOSEPH GLYNN, F.R.S., &c. New Edition, Illustrated. 2s.

98. *PRACTICAL MECHANISM,* the Elements of; and Machine Tools. By T. BAKER, C.E. With Remarks on Tools and Machinery, by J. NASMYTH, C.E. Plates. 2s. 6d.

114. *MACHINERY,* Elementary Principles of, in its Construction and Working. Illustrated by numerous Examples of Modern Machinery for different Branches of Manufacture. By C. D. ABEL, C.E. 1s. 6d.

15. *ATLAS OF PLATES.* Illustrating the above Treatise. By C. D. ABEL, C.E. 7s. 6d.

125. *THE COMBUSTION OF COAL AND THE PREVENTION* OF SMOKE, Chemically and Practically Considered. With an Appendix. By C. WYE WILLIAMS, A.I.C.E. Plates. 3s.

139. *THE STEAM ENGINE,* a Treatise on the Mathematical Theory of, with Rules at length, and Examples for the Use of Practical Men. By T. BAKER, C.E. Illustrated. 1s. 6d.

162. *THE BRASS FOUNDER'S MANUAL;* Instructions for Modelling, Pattern-Making, Moulding, Turning, Filing, Burnishing, Bronzing, &c. With copious Receipts, numerous Tables, and Notes on Prime Costs and Estimates. By WALTER GRAHAM. Illustrated. 2s. 6d.

164. *MODERN WORKSHOP PRACTICE,* as applied to Marine, Land, and Locomotive Engines, Floating Docks, Dredging Machines, Bridges, Cranes, Ship-building, &c., &c. By J. G. WINTON. Illustrated. 3s.

Mechanical Engineering, etc., *continued.*

165. *IRON AND HEAT*, exhibiting the Principles concerned in the Construction of Iron Beams, Pillars, and Bridge Girders, and the Action of Heat in the Smelting Furnace. By J. ARMOUR, C.E. 2s. 6d.

166. *POWER IN MOTION:* Horse-Power, Motion, Toothed-Wheel Gearing, Long and Short Driving Bands, Angular Forces. By JAMES ARMOUR, C.E. With 73 Diagrams. 2s. 6d.

167. *THE APPLICATION OF IRON TO THE CONSTRUCTION* OF BRIDGES, GIRDERS, ROOFS, AND OTHER WORKS. By FRANCIS CAMPIN, C.E. Second Edition, revised and corrected. Numerous Woodcuts. 2s. 6d.

171. *THE WORKMAN'S MANUAL OF ENGINEERING* DRAWING. By JOHN MAXTON, Engineer, Instructor in Engineering Drawing, Royal Naval College, Greenwich. Third Edition. Illustrated with 7 Plates and nearly 350 Woodcuts. 3s. 6d.

190. *STEAM AND THE STEAM ENGINE*, Stationary and Portable. Being an extension of Mr. John Sewell's "Treatise on Steam." By D. KINNEAR CLARK, M.I.C.E., Author of "Railway Machinery," &c., &c. With numerous Illustrations. 3s. 6d.

SHIPBUILDING, NAVIGATION, MARINE ENGINEERING, ETC.

51. *NAVAL ARCHITECTURE*, the Rudiments of; or, an Exposition of the Elementary Principles of the Science, and their Practical Application to Naval Construction. Compiled for the Use of Beginners. By JAMES PEAKE, School of Naval Architecture, H.M. Dockyard, Portsmouth. Fourth Edition, corrected, with Plates and Diagrams. 3s. 6d.

53*. *SHIPS FOR OCEAN AND RIVER SERVICE*, Elementary and Practical Principles of the Construction of. By HAKON A. SOMMERFELDT, Surveyor of the Royal Norwegian Navy. With an Appendix. 1s.

53**. *AN ATLAS OF ENGRAVINGS* to Illustrate the above. Twelve large folding plates. Royal 4to, cloth. 7s. 6d.

54. *MASTING, MAST-MAKING, AND RIGGING OF SHIPS*, Rudimentary Treatise on. Also Tables of Spars, Rigging, Blocks; Chain, Wire, and Hemp Ropes, &c., relative to every class of vessels. Together with an Appendix of Dimensions of Masts and Yards of the Royal Navy of Great Britain and Ireland. By ROBERT KIPPING, N.A. Fourteenth Edition. Illustrated. 2s.

54*. *IRON SHIP-BUILDING.* With Practical Examples and Details for the Use of Ship Owners and Ship Builders. By JOHN GRANTHAM, Consulting Engineer and Naval Architect. 5th Edition, with Additions. 4s.

54**. *AN ATLAS OF FORTY PLATES* to Illustrate the above. Fifth Edition. Including the latest Examples, such as H.M. Steam Frigates "Warrior," "Hercules," "Bellerophon;" H.M. Troop Ship "Serapis," Iron Floating Dock, &c., &c. 4to, boards. 38s.

55. *THE SAILOR'S SEA BOOK:* a Rudimentary Treatise on Navigation. I. How to Keep the Log and Work it off. II. On Finding the Latitude and Longitude. By JAMES GREENWOOD, B.A., of Jesus College, Cambridge. To which are added, Directions for Great Circle Sailing; an Essay on the Law of Storms and Variable Winds; and Explanations of Terms used in Ship-building. Ninth Edition, with several Engravings and Coloured Illustrations of the Flags of Maritime Nations. 2s.

80. *MARINE ENGINES, AND STEAM VESSELS*, a Treatise on. Together with Practical Remarks on the Screw and Propelling Power, as used in the Royal and Merchant Navy. By ROBERT MURRAY, C.E., Engineer-Surveyor to the Board of Trade. With a Glossary of Technical Terms, and their Equivalents in French, German, and Spanish. Fifth Edition, revised and enlarged. Illustrated. 3s.

Shipbuilding, Navigation, etc., *continued.*

83*bis*. *THE FORMS OF SHIPS AND BOATS:* Hints, Experimentally Derived, on some of the Principles regulating Ship-building. By W. BLAND. Sixth Edition, revised, with numerous Illustrations and Models. 1s. 6d.

99. *NAVIGATION AND NAUTICAL ASTRONOMY*, in Theory and Practice. With Attempts to facilitate the Finding of the Time and the Longitude at Sea. By J. R. YOUNG, formerly Professor of Mathematics in Belfast College. Illustrated. 2s. 6d.

100*. *TABLES* intended to facilitate the Operations of Navigation and Nautical Astronomy, as an Accompaniment to the above Book. By J. R. YOUNG. 1s. 6d.

106. *SHIPS' ANCHORS*, a Treatise on. By GEORGE COTSELL, N.A. Illustrated. 1s. 6d.

149. *SAILS AND SAIL-MAKING*, an Elementary Treatise on. With Draughting, and the Centre of Effort of the Sails. Also, Weights and Sizes of Ropes; Masting, Rigging, and Sails of Steam Vessels, &c., &c. Tenth Edition, enlarged, with an Appendix. By ROBERT KIPPING, N.A., Sailmaker, Quayside, Newcastle. Illustrated. 2s. 6d.

155. *THE ENGINEER'S GUIDE TO THE ROYAL AND* MERCANTILE NAVIES. By a PRACTICAL ENGINEER. Revised by D. F. M'CARTHY, late of the Ordnance Survey Office, Southampton. 3s.

PHYSICAL SCIENCE, NATURAL PHILOSOPHY, ETC.

1. *CHEMISTRY*, for the Use of Beginners. By Professor GEORGE FOWNES, F.R.S. With an Appendix, on the Application of Chemistry to Agriculture. 1s.

2. *NATURAL PHILOSOPHY*, Introduction to the Study of; for the Use of Beginners. By C. TOMLINSON, Lecturer on Natural Science in King's College School, London. Woodcuts. 1s. 6d.

4. *MINERALOGY*, Rudiments of; a concise View of the Properties of Minerals. By A. RAMSAY, Jun. Woodcuts and Steel Plates. 3s.

6. *MECHANICS*, Rudimentary Treatise on; being a concise Exposition of the General Principles of Mechanical Science, and their Applications. By CHARLES TOMLINSON, Lecturer on Natural Science in King's College School, London. Illustrated. 1s. 6d.

7. *ELECTRICITY;* showing the General Principles of Electrical Science, and the purposes to which it has been applied. By Sir W. SNOW HARRIS, F.R.S., &c. With considerable Additions by R. SABINE, C.E., F.S.A. Woodcuts. 1s. 6d.

7*. *GALVANISM*, Rudimentary Treatise on, and the General Principles of Animal and Voltaic Electricity. By Sir W. SNOW HARRIS. New Edition, revised, with considerable Additions, by ROBERT SABINE, C.E., F.S.A. Woodcuts. 1s. 6d.

8. *MAGNETISM;* being a concise Exposition of the General Principles of Magnetical Science, and the Purposes to which it has been applied. By Sir W. SNOW HARRIS. New Edition, revised and enlarged by H. M. NOAD, Ph.D., Vice-President of the Chemical Society, Author of "A Manual of Electricity," &c., &c. With 165 Woodcuts. 3s. 6d.

11. *THE ELECTRIC TELEGRAPH;* its History and Progress; with Descriptions of some of the Apparatus. By R. SABINE, C.E., F.S.A., &c. Woodcuts. 3s.

12. *PNEUMATICS*, for the Use of Beginners. By CHARLES TOMLINSON. Illustrated. 1s. 6d.

72. *MANUAL OF THE MOLLUSCA;* a Treatise on Recent and Fossil Shells. By Dr. S. P. WOODWARD, A.L.S. With Appendix by RALPH TATE, A.L.S., F.G.S. With numerous Plates and 300 Woodcuts, 6s. 6d. Cloth boards, 7s. 6d.

Physical Science, Natural Philosophy, etc., *continued.*

79**. *PHOTOGRAPHY*, Popular Treatise on; with a Description of the Stereoscope, &c. Translated from the French of D. VAN MONCKHOVEN, by W. H. THORNTHWAITE, Ph.D. Woodcuts. 1s. 6d.

96. *ASTRONOMY.* By the Rev. R. MAIN, M.A., F.R.S., &c. New and enlarged Edition, with an Appendix on "Spectrum Analysis." Woodcuts. 1s. 6d.

97. *STATICS AND DYNAMICS*, the Principles and Practice of; embracing also a clear development of Hydrostatics, Hydrodynamics, and Central Forces. By T. BAKER, C.E. 1s. 6d.

138. *TELEGRAPH*, Handbook of the; a Manual of Telegraphy, Telegraph Clerks' Remembrancer, and Guide to Candidates for Employment in the Telegraph Service. By R. BOND. Fourth Edition, revised and enlarged: to which is appended, QUESTIONS on MAGNETISM, ELECTRICITY, and PRACTICAL TELEGRAPHY, for the Use of Students, by W. MCGREGOR, First Assistant Superintendent, Indian Gov. Telegraphs. Woodcuts. 3s.

143. *EXPERIMENTAL ESSAYS.* By CHARLES TOMLINSON. I. On the Motions of Camphor on Water. II. On the Motion of Camphor towards the Light. III. History of the Modern Theory of Dew. Woodcuts. 1s.

173. *PHYSICAL GEOLOGY*, partly based on Major-General PORTLOCK'S "Rudiments of Geology." By RALPH TATE, A.L.S., &c. Numerous Woodcuts. 2s.

174. *HISTORICAL GEOLOGY*, partly based on Major-General PORTLOCK'S "Rudiments." By RALPH TATE, A.L.S., &c. Woodcuts. 2s. 6d.

173 & 174. *RUDIMENTARY TREATISE ON GEOLOGY*, Physical and Historical. Partly based on Major-General PORTLOCK'S "Rudiments of Geology." By RALPH TATE, A.L.S., F.G.S., &c., &c. Numerous Illustrations. In One Volume. 4s. 6d.

183. & 184. *ANIMAL PHYSICS*, Handbook of. By DIONYSIUS LARDNER, D.C.L., formerly Professor of Natural Philosophy and Astronomy in University College, London. With 520 Illustrations. In One Volume, cloth boards. 7s. 6d.

*** *Sold also in Two Parts, as follows:—*

183. ANIMAL PHYSICS. By Dr. LARDNER. Part I., Chapter I—VII. 4s.
184. ANIMAL PHYSICS. By Dr. LARDNER. Part II. Chapter VIII—XVIII. 3s.

MINING, METALLURGY, ETC.

117. *SUBTERRANEOUS SURVEYING*, Elementary and Practical Treatise on, with and without the Magnetic Needle. By THOMAS FENWICK, Surveyor of Mines, and THOMAS BAKER, C.E. Illustrated. 2s. 6d.

133. *METALLURGY OF COPPER;* an Introduction to the Methods of Seeking, Mining, and Assaying Copper, and Manufacturing its Alloys. By ROBERT H. LAMBORN, Ph.D. Woodcuts. 2s. 6d.

134. *METALLURGY OF SILVER AND LEAD.* A Description of the Ores; their Assay and Treatment, and valuable Constituents. By Dr. R. H. LAMBORN. Woodcuts. 2s

135. *ELECTRO-METALLURGY;* Practically Treated. By ALEXANDER WATT, F.R.S.S.A. New Edition, enlarged. Woodcuts. 2s. 6d.

172. *MINING TOOLS*, Manual of. For the Use of Mine Managers, Agents, Students, &c. Comprising Observations on the Materials from, and Processes by, which they are manufactured; their Special Uses, Applications, Qualities, and Efficiency. By WILLIAM MORGANS, Lecturer on Mining at the Bristol School of Mines. 2s. 6d.

172*. *MINING TOOLS, ATLAS* of Engravings to Illustrate the above, containing 235 Illustrations of Mining Tools, drawn to Scale. 4to 4s. 6d.

Mining, Metallurgy, etc., *continued.*

176. *METALLURGY OF IRON*, a Treatise on the. Containing History of Iron Manufacture, Methods of Assay, and Analyses of Iron Ores, Processes of Manufacture of Iron and Steel, &c. By H. BAUERMAN, F.G.S. Fourth Edition, enlarged, with numerous Illustrations. 4s. 6d.

180. *COAL AND COAL MINING:* A Rudimentary Treatise on. By WARINGTON W. SMYTH, M.A., F.R.S., &c., Chief Inspector of the Mines of the Crown and of the Duchy of Cornwall. New Edition, revised and corrected. With numerous Illustrations. 3s. 6d.

195. *THE MINERAL SURVEYOR AND VALUER'S COM-*PLETE GUIDE, with new Traverse Tables; and Descriptions of Improved Instruments; also the Correct Principles of Laying out and Valuing Mineral Properties. By WILLIAM LINTERN, Mining and Civil Engineer. With four Plates of Diagrams, Plans, &c. 3s. 6d. [*Now Ready.*

EMIGRATION.

154. *GENERAL HINTS TO EMIGRANTS.* Containing Notices of the various Fields for Emigration. With Hints on Preparation for Emigrating, Outfits, &c., &c. With Directions and Recipes useful to the Emigrant. With a Map of the World. 2s.

157. *THE EMIGRANT'S GUIDE TO NATAL.* By ROBERT JAMES MANN, F.R.A.S., F.M.S. Second Edition, carefully corrected to the present Date. Map. 2s.

159. *THE EMIGRANT'S GUIDE TO AUSTRALIA, New South Wales, Western Australia, South Australia, Victoria, and Queensland.* By the Rev. JAMES BAIRD, B.A. Map. 2s. 6d.

160. *THE EMIGRANT'S GUIDE TO TASMANIA and NEW ZEALAND.* By the Rev. JAMES BAIRD, B.A. With a Map. 2s.

159 & 160. *THE EMIGRANT'S GUIDE TO AUSTRALASIA.* By the Rev. J. BAIRD, B.A. Comprising the above two volumes, cloth boards. 5s.

AGRICULTURE.

29. *THE DRAINAGE OF DISTRICTS AND LANDS.* By G. DRYSDALE DEMPSEY, C.E. Illustrated. 1s. 6d.

*** *With "Drainage of Towns and Buildings," in One Vol., 3s. 6d.*

63. *AGRICULTURAL ENGINEERING:* Farm Buildings, Motive Powers and Machinery of the Steading, Field Machines, and Implements. By G. H. ANDREWS, C.E. Illustrated. 3s.

66. *CLAY LANDS AND LOAMY SOILS.* By Professor DONALDSON. 1s.

131. *MILLER'S, MERCHANT'S, AND FARMER'S READY* RECKONER, for ascertaining at sight the value of any quantity of Corn, from One Bushel to One Hundred Quarters, at any given price, from £1 to £5 per Qr. With approximate values of Millstones, Millwork, &c. 1s.

140. *SOILS, MANURES, AND CROPS.* (Vol. 1. OUTLINES OF MODERN FARMING.) By R. SCOTT BURN. Woodcuts. 2s.

141. *FARMING AND FARMING ECONOMY,* Notes, Historical and Practical, on. (Vol. 2. OUTLINES OF MODERN FARMING.) By R. SCOTT BURN. Woodcuts. 2s.

142. *STOCK; CATTLE, SHEEP, AND HORSES.* (Vol. 3. OUTLINES OF MODERN FARMING.) By R. SCOTT BURN. Woodcuts. 2s. 6d.

145. *DAIRY, PIGS, AND POULTRY,* Management of the. By R. SCOTT BURN. With Notes on the Diseases of Stock. (Vol. 4. OUTLINES OF MODERN FARMING.) Woodcuts. 2s.

146. *UTILIZATION OF SEWAGE, IRRIGATION, AND* RECLAMATION OF WASTE LAND. (Vol. 5. OUTLINES OF MODERN FARMING.) By R. SCOTT BURN. Woodcuts. 2s. 6d.

*** Nos. 140-1-2-5-6, in One Vol., handsomely half-bound, entitled "OUTLINES OF MODERN FARMING." By ROBERT SCOTT BURN. Price 12s.

177. *FRUIT TREES,* The Scientific and Profitable Culture of. From the French of DU BREUIL, Revised by GEO. GLENNY. 187 Woodcuts. 3s. 6d.

FINE ARTS.

20. *PERSPECTIVE FOR BEGINNERS.* Adapted to Young Students and Amateurs in Architecture, Painting, &c. By GEORGE PYNE, Artist. Woodcuts. 2s.

40 & 41. *GLASS STAINING;* or, Painting on Glass, The Art of. Comprising Directions for Preparing the Pigments and Fluxes, laying them upon the Glass, and Firing or Burning in the Colours. From the German of Dr. GESSERT. To which is added, an Appendix on THE ART OF ENAMELLING, &c., with THE ART OF PAINTING ON GLASS. From the German of EMANUEL OTTO FROMBERG. In One Volume. 2s. 6d.

69. *MUSIC,* A Rudimentary and Practical Treatise on. With numerous Examples. By CHARLES CHILD SPENCER. 2s. 6d.

71. *PIANOFORTE,* The Art of Playing the. With numerous Exercises and Lessons. Written and Selected from the Best Masters, by CHARLES CHILD SPENCER. 1s. 6d.

181. *PAINTING POPULARLY EXPLAINED,* including Fresco, Oil, Mosaic, Water Colour, Water-Glass, Tempera, Encaustic, Miniature, Painting on Ivory, Vellum, Pottery, Enamel, Glass, &c. With Historical Sketches of the Progress of the Art by THOMAS JOHN GULLICK, assisted by JOHN TIMBS, F.S.A. Third Edition, revised and enlarged, with Frontispiece and Vignette. 5s.

186. *A GRAMMAR OF COLOURING,* applied to Decorative Painting and the Arts. By GEORGE FIELD. New Edition, enlarged and adapted to the Use of the Ornamental Painter and Designer. By ELLIS A. DAVIDSON, Author of "Drawing for Carpenters," &c. With two new Coloured Diagrams and numerous Engravings on Wood. 2s. 6d.

ARITHMETIC, GEOMETRY, MATHEMATICS, ETC.

32. *MATHEMATICAL INSTRUMENTS,* a Treatise on; in which their Construction and the Methods of Testing, Adjusting, and Using them are concisely Explained. By J. F. HEATHER, M.A., of the Royal Military Academy, Woolwich. Original Edition, in 1 vol., Illustrated. 1s. 6d.

*** *In ordering the above, be careful to say, "Original Edition," or give the number in the Series* (32) *to distinguish it from the Enlarged Edition in* 3 *vols.* (*Nos.* 168-9-70.)

60. *LAND AND ENGINEERING SURVEYING,* a Treatise on; with all the Modern Improvements. Arranged for the Use of Schools and Private Students; also for Practical Land Surveyors and Engineers. By T. BAKER, C.E. New Edition, revised by EDWARD NUGENT, C.E. Illustrated with Plates and Diagrams. 2s.

61*. *READY RECKONER FOR THE ADMEASUREMENT OF* LAND. By ABRAHAM ARMAN, Schoolmaster, Thurleigh, Beds. To which is added a Table, showing the Price of Work, from 2s. 6d. to £1 per acre, and Tables for the Valuation of Land, from 1s. to £1,000 per acre, and from one pole to two thousand acres in extent, &c., &c. 1s. 6d.

76. *DESCRIPTIVE GEOMETRY,* an Elementary Treatise on; with a Theory of Shadows and of Perspective, extracted from the French of G. MONGE. To which is added, a description of the Principles and Practice of Isometrical Projection; the whole being intended as an introduction to the Application of Descriptive Geometry to various branches of the Arts. By J. F. HEATHER, M.A. Illustrated with 14 Plates. 2s.

178. *PRACTICAL PLANE GEOMETRY:* giving the Simplest Modes of Constructing Figures contained in one Plane and Geometrical Construction of the Ground. By J. F. HEATHER, M.A. With 215 Woodcuts. 2s.

9. *PROJECTION:* Orthographic, Topographic, and Perspective: giving the various Modes of Delineating Solid Forms by Constructions on a Single Plane Surface. By J. F. HEATHER, M.A. [*In preparation.*

*** *The above three volumes will form a* COMPLETE ELEMENTARY COURSE OF MATHEMATICAL DRAWING.

Arithmetic, Geometry, Mathematics, etc., *continued.*

83. *COMMERCIAL BOOK-KEEPING.* With Commercial Phrases and Forms in English, French, Italian, and German. By JAMES HADDON, M.A., Arithmetical Master of King's College School, London. 1s.

84. *ARITHMETIC,* a Rudimentary Treatise on: with full Explanations of its Theoretical Principles, and numerous Examples for Practice. For the Use of Schools and for Self-Instruction. By J. R. YOUNG, late Professor of Mathematics in Belfast College. New Edition, with Index. 1s. 6d.

84*. A KEY to the above, containing Solutions in full to the Exercises, together with Comments, Explanations, and Improved Processes, for the Use of Teachers and Unassisted Learners. By J. R. YOUNG. 1s. 6d.

85. *EQUATIONAL ARITHMETIC,* applied to Questions of Interest,
85*. Annuities, Life Assurance, and General Commerce; with various Tables by which all Calculations may be greatly facilitated. By W. HIPSLEY. 2s.

86. *ALGEBRA,* the Elements of. By JAMES HADDON, M.A., Second Mathematical Master of King's College School. With Appendix, containing miscellaneous Investigations, and a Collection of Problems in various parts of Algebra. 2s.

86*. A KEY AND COMPANION to the above Book, forming an extensive repository of Solved Examples and Problems in Illustration of the various Expedients necessary in Algebraical Operations. Especially adapted for Self-Instruction. By J. R. YOUNG. 1s. 6d.

88. *EUCLID,* THE ELEMENTS OF: with many additional Propositions
89. and Explanatory Notes: to which is prefixed, an Introductory Essay on Logic. By HENRY LAW, C.E. 2s. 6d.

*** *Sold also separately, viz.:—*

88. EUCLID, The First Three Books. By HENRY LAW, C.E. 1s.

89. EUCLID, Books 4, 5, 6, 11, 12. By HENRY LAW, C.E. 1s. 6d.

90. *ANALYTICAL GEOMETRY AND CONIC SECTIONS,* a Rudimentary Treatise on. By JAMES HANN, late Mathematical Master or King's College School, London. A New Edition, re-written and enlarged by J. R. YOUNG, formerly Professor of Mathematics at Belfast College. 2s.

91. *PLANE TRIGONOMETRY,* the Elements of. By JAMES HANN, formerly Mathematical Master of King's College, London. 1s.

92. *SPHERICAL TRIGONOMETRY,* the Elements of. By JAMES HANN. Revised by CHARLES H. DOWLING, C.E. 1s.

*** *Or with "The Elements of Plane Trigonometry," in One Volume,* 2s.

93. *MENSURATION AND MEASURING,* for Students and Practical Use. With the Mensuration and Levelling of Land for the Purposes or Modern Engineering. By T. BAKER, C.E. New Edition, with Corrections and Additions by E. NUGENT, C.E. Illustrated. 1s. 6d.

94. *LOGARITHMS,* a Treatise on; with Mathematical Tables for facilitating Astronomical, Nautical, Trigonometrical, and Logarithmic Calculations; Tables of Natural Sines and Tangents and Natural Cosines. By HENRY LAW, C.E. Illustrated. 2s. 6d.

101*. *MEASURES, WEIGHTS, AND MONEYS OF ALL NATIONS,* and an Analysis of the Christian, Hebrew, and Mahometan Calendars. By W. S. B. WOOLHOUSE, F.R.A.S., &c. 1s. 6d.

102. *INTEGRAL CALCULUS,* Rudimentary Treatise on the. By HOMERSHAM COX, B.A. Illustrated. 1s.

103. *INTEGRAL CALCULUS,* Examples on the. By JAMES HANN, late of King's College, London. Illustrated. 1s.

101. *DIFFERENTIAL CALCULUS,* Examples of the. By W. S. B. WOOLHOUSE, F.R.A.S., &c. 1s. 6d.

104. *DIFFERENTIAL CALCULUS,* Examples and Solutions of the. By JAMES HADDON, M.A. 1s.

Arithmetic, Geometry, Mathematics, etc., *continued.*

105. *MNEMONICAL LESSONS.* — GEOMETRY, ALGEBRA, AND TRIGONOMETRY, in Easy Mnemonical Lessons. By the Rev. THOMAS PENYNGTON KIRKMAN, M.A. 1s. 6d.

136. *ARITHMETIC,* Rudimentary, for the Use of Schools and Self-Instruction. By JAMES HADDON, M.A. Revised by ABRAHAM ARMAN. 1s. 6d.

137. A KEY TO HADDON'S RUDIMENTARY ARITHMETIC. By A. ARMAN. 1s. 6d.

147. *ARITHMETIC,* STEPPING-STONE TO; being a Complete Course of Exercises in the First Four Rules (Simple and Compound), on an entirely new principle. For the Use of Elementary Schools of every Grade. Intended as an Introduction to the more extended works on Arithmetic. By ABRAHAM ARMAN. 1s.

148. A KEY TO STEPPING-STONE TO ARITHMETIC. By A. ARMAN. 1s.

158. *THE SLIDE RULE, AND HOW TO USE IT;* containing full, easy, and simple Instructions to perform all Business Calculations with unexampled rapidity and accuracy. By CHARLES HOARE, C.E. With a Slide Rule in tuck of cover. 3s.

168. *DRAWING AND MEASURING INSTRUMENTS.* Including—I. Instruments employed in Geometrical and Mechanical Drawing, and in the Construction, Copying, and Measurement of Maps and Plans. II. Instruments used for the purposes of Accurate Measurement, and for Arithmetical Computations. By J. F. HEATHER, M.A., late of the Royal Military Academy, Woolwich, Author of "Descriptive Geometry," &c., &c. Illustrated. 1s. 6d.

169. *OPTICAL INSTRUMENTS.* Including (more especially) Telescopes, Microscopes, and Apparatus for producing copies of Maps and Plans by Photography. By J. F. HEATHER, M.A. Illustrated. 1s. 6d.

170. *SURVEYING AND ASTRONOMICAL INSTRUMENTS.* Including—I. Instruments Used for Determining the Geometrical Features of a portion of Ground. II. Instruments Employed in Astronomical Observations. By J. F. HEATHER, M.A. Illustrated. 1s. 6d.

*** *The above three volumes form an enlargement of the Author's original work, "Mathematical Instruments: their Construction, Adjustment, Testing, and Use," the Eleventh Edition of which is on sale, price 1s. 6d. (See No. 32 in the Series.)*

168.
169.
170. } *MATHEMATICAL INSTRUMENTS.* By J. F. HEATHER, M.A. Enlarged Edition, for the most part entirely re-written. The 3 Parts as above, in One thick Volume. With numerous Illustrations. 4s. 6d.

185. *THE COMPLETE MEASURER;* setting forth the Measurement of Boards, Glass, &c., &c.; Unequal-sided, Square-sided, Octagonal-sided, Round Timber and Stone, and Standing Timber. With a Table showing the solidity of hewn or eight-sided timber, or of any octagonal-sided column. Compiled for the accommodation of Timber-growers, Merchants, and Surveyors, Stonemasons, Architects, and others. By RICHARD HORTON. Third Edition, with valuable additions. 4s.

196. *THEORY OF COMPOUND INTEREST AND ANNUITIES;* with Tables of Logarithms for the more Difficult Computations of Interest, Discount, Annuities, &c. By FÉDOR THOMAN, of the Société Crédit Mobilier, Paris. 4s. [*Now ready.*

LEGAL TREATISES.

50. *THE LAW OF CONTRACTS FOR WORKS AND SERVICES.* By DAVID GIBBONS. Third Edition, revised and considerably enlarged. 3s. [*Just published.*

151. *A HANDY BOOK ON THE LAW OF FRIENDLY, INDUSTRIAL & PROVIDENT BUILDING & LOAN SOCIETIES.* With copious Notes. By NATHANIEL WHITE, of H.M. Civil Service. 1s.

163. *THE LAW OF PATENTS FOR INVENTIONS;* and on the Protection of Designs and Trade Marks. By F. W. CAMPIN, Barrister-at-Law. 2s.

MISCELLANEOUS VOLUMES.

36. *A DICTIONARY OF TERMS used in ARCHITECTURE, BUILDING, ENGINEERING, MINING, METALLURGY, ARCHÆOLOGY, the FINE ARTS, &c.* By JOHN WEALE. Fifth Edition. Revised by ROBERT HUNT, F.R.S., Keeper of Mining Records. Numerous Illustrations. 5s.

112. *MANUAL OF DOMESTIC MEDICINE.* By R. GOODING, B.A., M.B. Intended as a Family Guide in all Cases of Accident and Emergency. 2s.

112*. *MANAGEMENT OF HEALTH.* A Manual of Home and Personal Hygiene. By the Rev. JAMES BAIRD, B.A. 1s.

113. *FIELD ARTILLERY ON SERVICE.* By TAUBERT, Captain Prussian Artillery. Translated by Lieut.-Col. H. H. MAXWELL. 1s. 6d.

113*. *SWORDS, AND OTHER ARMS.* By Col. MAREY. Translated by Col. H. H. MAXWELL. With Plates. 1s.

150. *LOGIC,* Pure and Applied. By S. H. EMMENS. Third Edition. 1s. 6d.

152. *PRACTICAL HINTS FOR INVESTING MONEY.* With an Explanation of the Mode of Transacting Business on the Stock Exchange. By FRANCIS PLAYFORD, Sworn Broker. 1s. 6d.

153. *SELECTIONS FROM LOCKE'S ESSAYS ON THE HUMAN UNDERSTANDING.* With Notes by S. H. EMMENS. 2s.

193. *HANDBOOK OF FIELD FORTIFICATION,* intended for the Guidance of Officers Preparing for Promotion, and especially adapted to the requirements of Beginners. By Major W. W. KNOLLYS, F.R.G.S., 93rd Sutherland Highlanders, &c. With 163 Woodcuts. 3s.

194. *THE HOUSE MANAGER:* Being a Guide to Housekeeping. Practical Cookery, Pickling and Preserving, Household Work, Dairy Management, the Table and Dessert, Cellarage of Wines, Home-brewing and Wine-making, the Boudoir and Dressing-room, Travelling, Stable Economy, Gardening Operations, &c. By AN OLD HOUSEKEEPER. 3s. 6d.

EDUCATIONAL AND CLASSICAL SERIES.

HISTORY.

1. **England, Outlines of the History of;** more especially with reference to the Origin and Progress of the English Constitution. A Text Book for Schools and Colleges. By WILLIAM DOUGLAS HAMILTON, F.S.A., of Her Majesty's Public Record Office. Fourth Edition, revised. Maps and Woodcuts. 5s.; cloth boards, 6s.

5. **Greece, Outlines of the History of;** in connection with the Rise of the Arts and Civilization in Europe. By W. DOUGLAS HAMILTON, of University College, London, and EDWARD LEVIEN, M.A., of Balliol College, Oxford. 2s. 6d.; cloth boards, 3s. 6d.

7. **Rome, Outlines of the History of:** from the Earliest Period to the Christian Era and the Commencement of the Decline of the Empire. By EDWARD LEVIEN, of Balliol College, Oxford. Map, 2s. 6d.; cl. bds. 3s. 6d.

9. **Chronology of History, Art, Literature, and Progress,** from the Creation of the World to the Conclusion of the Franco-German War. The Continuation by W. D. HAMILTON, F.S.A., of Her Majesty's Record Office. 3s.; cloth boards, 3s. 6d.

50. **Dates and Events in English History,** for the use of Candidates in Public and Private Examinations. By the Rev. E. RAND. 1s.

ENGLISH LANGUAGE AND MISCELLANEOUS.

11. **Grammar of the English Tongue, Spoken and Written.** With an Introduction to the Study of Comparative Philology. By HYDE CLARKE, D.C.L. Third Edition. 1s.

11*. **Philology: Handbook of the Comparative Philology of English,** Anglo-Saxon, Frisian, Flemish or Dutch, Low or Platt Dutch, High Dutch or German, Danish, Swedish, Icelandic, Latin, Italian, French, Spanish, and Portuguese Tongues. By HYDE CLARKE, D.C.L. 1s.

12. **Dictionary of the English Language,** as Spoken and Written. Containing above 100,000 Words. By HYDE CLARKE, D.C.L. 3s. 6d.; cloth boards, 4s. 6d.; complete with the GRAMMAR, cloth bds., 5s. 6d.

48. **Composition and Punctuation,** familiarly Explained for those who have neglected the Study of Grammar. By JUSTIN BRENAN. 16th Edition. 1s.

49. **Derivative Spelling-Book: Giving the Origin of Every Word** from the Greek, Latin, Saxon, German, Teutonic, Dutch, French, Spanish, and other Languages; with their present Acceptation and Pronunciation. By J. ROWBOTHAM, F.R.A.S. Improved Edition. 1s. 6d.

51. **The Art of Extempore Speaking: Hints for the Pulpit,** the Senate, and the Bar. By M. BAUTAIN, Vicar-General and Professor at the Sorbonne. Translated from the French. Sixth Edition, carefully corrected. 2s. 6d.

52. **Mining and Quarrying,** with the Sciences connected therewith. First Book of, for Schools. By J. H. COLLINS, F.G.S., Lecturer to the Miners' Association of Cornwall and Devon. 1s.

53. **Places and Facts in Political and Physical Geography,** for Candidates in Public and Private Examinations. By the Rev. EDGAR RAND, B.A. 1s.

54. **Analytical Chemistry, Qualitative and Quantitative,** a Course of. To which is prefixed, a Brief Treatise upon Modern Chemical Nomenclature and Notation. By WM. W. PINK, Practical Chemist, &c., and GEORGE E. WEBSTER, Lecturer on Metallurgy and the Applied Sciences, Nottingham. 2s.

THE SCHOOL MANAGERS' SERIES OF READING BOOKS,

Adapted to the Requirements of the New Code. Edited by the Rev. A. R. GRANT, Rector of Hitcham, and Honorary Canon of Ely; formerly H.M. Inspector of Schools.

INTRODUCTORY PRIMER, 3*d.*

	s.	*d.*		*s.*	*d.*
FIRST STANDARD . .	0	6	FOURTH STANDARD . . .	1	2
SECOND ,, . .	0	10	FIFTH ,, ...	1	6
THIRD ,, . .	1	0	SIXTH ,, ...	1	6

LESSONS FROM THE BIBLE. Part I. Old Testament. 1s.

LESSONS FROM THE BIBLE. Part II. New Testament, to which is added THE GEOGRAPHY OF THE BIBLE, for very young Children. By Rev. C. THORNTON FORSTER. 1s. 2d. **** Or the Two Parts in One Volume. 2s.

FRENCH.

24. **French Grammar.** With Complete and Concise Rules on the Genders of French Nouns. By G. L. STRAUSS, Ph.D. 1s.

25. **French-English Dictionary.** Comprising a large number of New Terms used in Engineering, Mining, on Railways, &c. By ALFRED ELWES. 1s. 6d.

26. **English-French Dictionary.** By ALFRED ELWES. 2s.

25,26. **French Dictionary** (as above). Complete, in One Vol., 3s.; cloth boards, 3s. 6d. **** Or with the GRAMMAR, cloth boards, 4s. 6d.

French, *continued.*

47. **French and English Phrase Book:** containing Introductory Lessons, with Translations, for the convenience of Students; several Vocabularies of Words, a Collection of suitable Phrases, and Easy Familiar Dialogues. 1s.

GERMAN.

39. **German Grammar.** Adapted for English Students, from Heyse's Theoretical and Practical Grammar, by Dr. G. L. STRAUSS. 1s.

40. **German Reader:** A Series of Extracts, carefully culled from the most approved Authors of Germany; with Notes, Philological and Explanatory. By G. L. STRAUSS, Ph.D. 1s.

41. **German Triglot Dictionary.** By NICHOLAS ESTERHAZY, S. A. HAMILTON. Part I. English-German-French. 1s.

42. **German Triglot Dictionary.** Part II. German-French-English. 1s.

43. **German Triglot Dictionary.** Part III. French-German-English. 1s.

41-43. **German Triglot Dictionary** (as above), in One Vol., 3s.; cloth boards, 4s. *** Or with the GERMAN GRAMMAR, cloth boards, 5s.

ITALIAN.

27. **Italian Grammar,** arranged in Twenty Lessons, with a Course of Exercises. By ALFRED ELWES. 1s.

28. **Italian Triglot Dictionary,** wherein the Genders of all the Italian and French Nouns are carefully noted down. By ALFRED ELWES. Vol. 1. Italian-English-French. 2s.

30. **Italian Triglot Dictionary.** By A. ELWES. Vol. 2. English-French-Italian. 2s.

32. **Italian Triglot Dictionary.** By ALFRED ELWES. Vol. 3. French-Italian-English. 2s.

28,30, 32. **Italian Triglot Dictionary** (as above). In One Vol., 6s.; cloth boards, 7s. 6d. *** Or with the ITALIAN GRAMMAR, cloth bds., 8s. 6d.

SPANISH AND PORTUGUESE.

34. **Spanish Grammar,** in a Simple and Practical Form. With a Course of Exercises. By ALFRED ELWES. 1s. 6d.

35. **Spanish-English and English-Spanish Dictionary.** Including a large number of Technical Terms used in Mining, Engineering, &c., with the proper Accents and the Gender of every Noun. By ALFRED ELWES. 4s.; cloth boards, 5s. *** Or with the GRAMMAR, cloth boards, 6s.

55. **Portuguese Grammar,** in a Simple and Practical Form. With a Course of Exercises. By ALFRED ELWES, Author of "A Spanish Grammar," &c. 1s. 6d. [*Just published.*

HEBREW.

46*. **Hebrew Grammar.** By Dr. BRESSLAU. 1s. 6d.

44. **Hebrew and English Dictionary,** Biblical and Rabbinical; containing the Hebrew and Chaldee Roots of the Old Testament Post-Rabbinical Writings. By Dr. BRESSLAU. 6s. *** Or with the GRAMMAR, 7s.

46. **English and Hebrew Dictionary.** By Dr. BRESSLAU. 3s.

44,46. 46*. **Hebrew Dictionary** (as above), in Two Vols., complete, with the GRAMMAR, cloth boards, 12s.

LATIN.

19. **Latin Grammar.** Containing the Inflections and Elementary Principles of Translation and Construction. By the Rev. THOMAS GOODWIN, M.A., Head Master of the Greenwich Proprietary School. 1s.

20. **Latin-English Dictionary.** Compiled from the best Authorities. By the Rev. THOMAS GOODWIN, M.A. 2s.

22. **English-Latin Dictionary;** together with an Appendix of French and Italian Words which have their origin from the Latin. By the Rev. THOMAS GOODWIN, M.A. 1s. 6d.

20,22. **Latin Dictionary** (as above). Complete in One Vol., 3s. 6d.; cloth boards, 4s. 6d. *** Or with the GRAMMAR, cloth boards, 5s. 6d.

LATIN CLASSICS. With Explanatory Notes in English.

1. **Latin Delectus.** Containing Extracts from Classical Authors, with Genealogical Vocabularies and Explanatory Notes, by HENRY YOUNG, lately Second Master of the Royal Grammar School, Guildford. 1s.

2. **Cæsaris Commentarii de Bello Gallico.** Notes, and a Geographical Register for the Use of Schools, by H. YOUNG. 2s.

12. **Ciceronis Oratio pro Sexto Roscio Amerino.** Edited, with an Introduction, Analysis, and Notes Explanatory and Critical, by the Rev. JAMES DAVIES, M.A. 1s.

14. **Ciceronis Cato Major, Lælius, Brutus, sive de Senectute, de Amicitia, de Claris Oratoribus Dialogi.** With Notes by W. BROWNRIGG SMITH, M.A., F.R.G.S. 2s.

3. **Cornelius Nepos.** With Notes. Intended for the Use of Schools. By H. YOUNG. 1s.

6. **Horace;** Odes, Epode, and Carmen Sæculare. Notes by H. YOUNG. 1s. 6d.

7. **Horace;** Satires, Epistles, and Ars Poetica. Notes by W. BROWNRIGG SMITH, M.A., F.R.G.S. 1s. 6d.

21. **Juvenalis Satiræ.** With Prolegomena and Notes by T. H. S. ESCOTT, B.A., Lecturer on Logic at King's College, London. 1s. 6d.

16. **Livy:** History of Rome. Notes by H. YOUNG and W. B. SMITH, M.A. Part 1. Books i., ii., 1s. 6d.

16*. ——— Part 2. Books iii., iv., v., 1s. 6d.

17. ——— Part 3 Books xxi., xxii., 1s. 6d.

8. **Sallustii Crispi Catalina et Bellum Jugurthinum.** Notes Critical and Explanatory, by W. M. DONNE, B.A., Trinity College, Cambridge. 1s. 6d.

10. **Terentii Adelphi, Hecyra, Phormio.** Edited, with Notes, Critical and Explanatory, by the Rev. JAMES DAVIES, M.A. 2s.

9. **Terentii Andria et Heautontimorumenos.** With Notes, Critical and Explanatory, by the Rev. JAMES DAVIES, M.A. 1s. 6d.

11. **Terentii Eunuchus, Comœdia.** Edited, with Notes, by the Rev. JAMES DAVIES, M.A. 1s. 6d. Or the Adelphi, Andria, and Eunuchus, 3 vols. in 1, cloth boards, 6s.

4. **Virgilii Maronis Bucolica et Georgica.** With Notes on the Bucolics by W. RUSHTON, M.A., and on the Georgics by H. YOUNG. 1s. 6d.

5. **Virgilii Maronis Æneis.** Notes, Critical and Explanatory, by H. YOUNG. 2s.

19. **Latin Verse Selections,** from Catullus, Tibullus, Propertius, and Ovid. Notes by W. B. DONNE, M.A., Trinity College, Cambridge. 2s.

20. **Latin Prose Selections,** from Varro, Columella, Vitruvius, Seneca, Quintilian, Florus, Velleius Paterculus, Valerius Maximus Suetonius, Apuleius, &c. Notes by W. B. DONNE, M.A. 2s.

☞ *Other Volumes are in Preparation.*

GREEK.

14. **Greek Grammar**, in accordance with the Principles and Philological Researches of the most eminent Scholars of our own day. By HANS CLAUDE HAMILTON. 1s. 6d.

15,17. **Greek Lexicon.** Containing all the Words in General Use, with their Significations, Inflections, and Doubtful Quantities. By HENRY R. HAMILTON. Vol. 1. Greek-English, 2s.; Vol. 2. English-Greek, 2s. Or the Two Vols. in One, 4s.: cloth boards, 5s.

14,15. **Greek Lexicon** (as above). Complete, with the GRAMMAR, in 17. One Vol., cloth boards, 6s.

GREEK CLASSICS. With Explanatory Notes in English.

1. **Greek Delectus.** Containing Extracts from Classical Authors, with Genealogical Vocabularies and Explanatory Notes, by H. YOUNG. New Edition, with an improved and enlarged Supplementary Vocabulary, by JOHN HUTCHISON, M.A., of the High School, Glasgow. 1s.

30. **Æschylus: Prometheus Vinctus: The Prometheus Bound.** From the Text of DINDORF. Edited, with English Notes, Critical and Explanatory, by the Rev. JAMES DAVIES, M.A. 1s.

32. **Æschylus: Septem Contra Thebes: The Seven against Thebes.** From the Text of DINDORF. Edited, with English Notes, Critical and Explanatory, by the Rev. JAMES DAVIES, M.A. 1s.

40. **Aristophanes: Acharnians.** Chiefly from the Text of C. H. WEISE. With Notes, by C. S. T. TOWNSHEND, M.A. 1s. 6d.

26. **Euripides: Alcestis.** Chiefly from the Text of DINDORF. With Notes, Critical and Explanatory, by JOHN MILNER, B.A. 1s.

23. **Euripides: Hecuba and Medea.** Chiefly from the Text of DINDORF. With Notes, Critical and Explanatory, by W. BROWNRIGG SMITH, M.A., F.R.G.S. 1s. 6d.

14-17. **Herodotus, The History of,** chiefly after the Text of GAISFORD. With Preliminary Observations and Appendices, and Notes, Critical and Explanatory, by T. H. L. LEARY, M.A., D.C.L.
Part 1. Books i., ii. (The Clio and Euterpe), 2s.
Part 2. Books iii., iv. (The Thalia and Melpomene), 2s.
Part 3. Books v.-vii. (The Terpsichore, Erato, and Polymnia), 2s.
Part 4. Books viii., ix. (The Urania and Calliope) and Index, 1s. 6d.

5-12. **Homer, The Works of.** According to the Text of BAEUMLEIN. With Notes, Critical and Explanatory, drawn from the best and latest Authorities, with Preliminary Observations and Appendices, by T. H. L. LEARY, M.A., D.C.L.

THE ILIAD: Part 1. Books i. to vi., 1s. 6d. | Part 3. Books xiii. to xviii., 1s. 6d.
Part 2. Books vii. to xii., 1s. 6d. | Part 4. Books xix. to xxiv., 1s. 6d.

THE ODYSSEY: Part 1. Books i. to vi., 1s. 6d. | Part 3. Books xiii. to xviii., 1s. 6d.
Part 2. Books vii. to xii., 1s. 6d. | Part 4. Books xix. to xxiv., and Hymns, 2s.

4. **Lucian's Select Dialogues.** The Text carefully revised, with Grammatical and Explanatory Notes, by H. YOUNG. 1s.

13. **Plato's Dialogues: The Apology of Socrates, the Crito, and the Phædo.** From the Text of C. F. HERMANN. Edited with Notes, Critical and Explanatory, by the Rev. JAMES DAVIES, M.A. 2s.

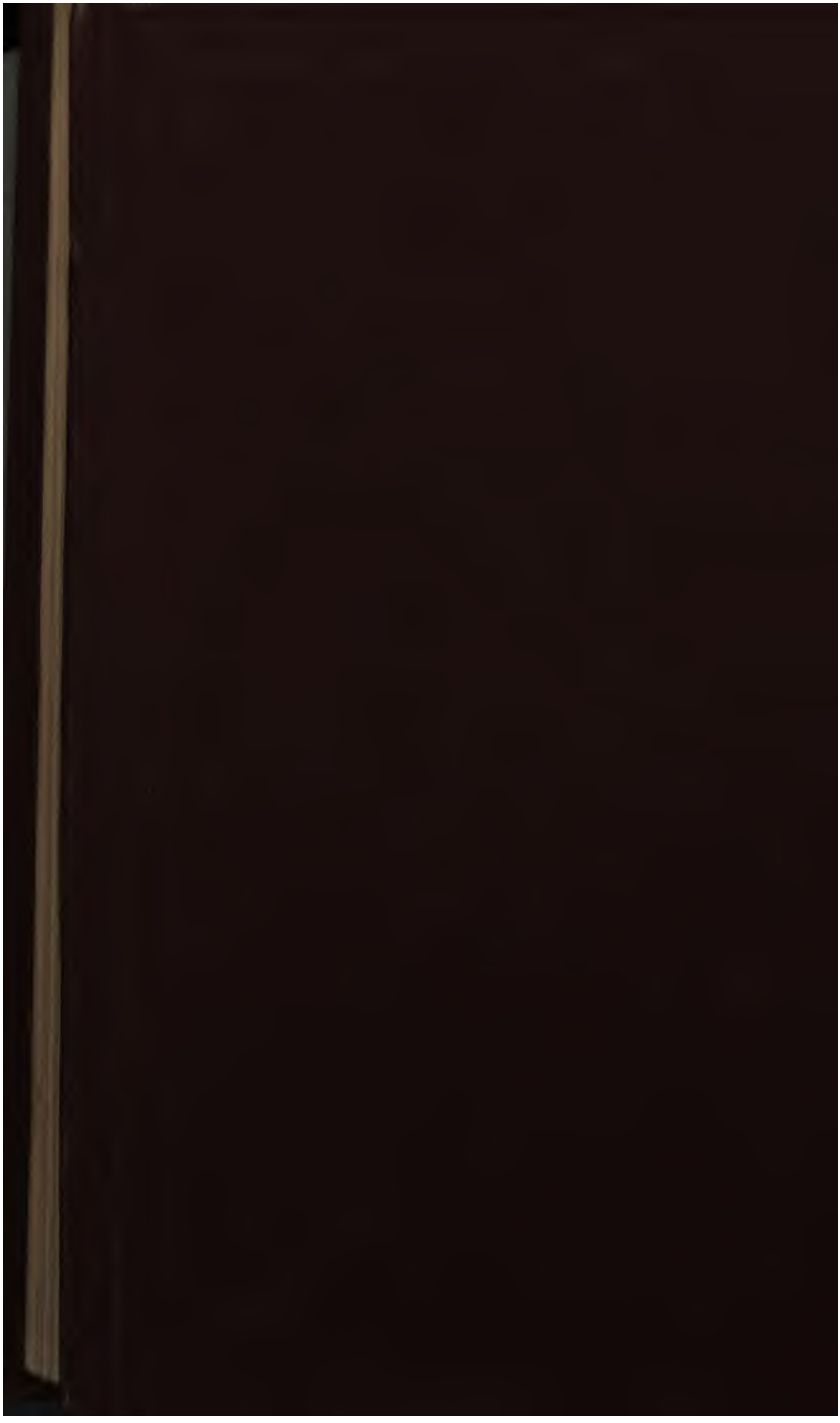
18. **Sophocles: Œdipus Tyrannus.** Notes by H. YOUNG. 1s.

20. **Sophocles: Antigone.** From the Text of DINDORF. Notes, Critical and Explanatory, by the Rev. JOHN MILNER, B.A. 2s.

41. **Thucydides: History of the Peloponnesian War.** Notes by H. YOUNG. Book 1. 1s.

2, 3. **Xenophon's Anabasis; or, The Retreat of the Ten Thousand.** Notes and a Geographical Register, by H. YOUNG. Part 1. Books i. to iii., 1s. Part 2. Books iv. to vii., 1s.

42. **Xenophon's Panegyric on Agesilaus.** Notes and Introduction by LL. F. W. JEWITT. 1s. 6d.

☞ *Other Volumes are in Preparation.*

CROSBY LOCKWOOD AND CO., 7, STATIONERS' HALL COURT, E.C.